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Early Childhood Adversity and Chronic Illness: An Examination of a High Risk- Forensic Inpatient Population

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ABSTRACT

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Individuals exposed adverse childhood experiences (ACEs) are at increased risk of developing chronic illnesses in adulthood including heart disease, cancer, diabetes, and chronic pain. A relationship between ACEs and health risk factors contributing to chronic disease such as smoking, obesity, and sedentary lifestyle has also been established in prior literature. There is evidence that higher that individuals in forensic inpatient mental health samples are disproportionally exposed to ACEs, which may increase odds of chronic disease development. Despite this evidence, little research has examined the prevalence of ACEs and relationships between ACEs and chronic health conditions and risky health behaviors in this population. This study evaluated these variables using archival data collected as part of a large interdisciplinary study from a forensic psychiatric facility. A list of clients (N=182) meeting inclusion criteria was randomly generated and a comprehensive record review was used to ascertain ACE scores and rates of health-risk behaviors and chronic conditions. Findings offered support for increased rates of childhood adversity and a significant relationship between ACE scores and health-risk behaviors within a forensic inpatient mental health population. However, relationships between ACEs and chronic illnesses and health-risk behaviors and chronic illnesses failed to reach significance. The lack of significance in these relationships suggests that ACEs are less singularly predictive of chronic illness within this population and instead different factors may drive the development of chronic illness.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Adverse Childhood Experiences

Adverse Childhood Experiences (ACEs) collectively describe early occurrences of abuse, neglect, and household dysfunction. The original ACE study (Felitti et al., 1998) sought to establish national rates of childhood adversity and examine their relationship to various health outcomes, including disease prevalence and risk factors, health care utilization, and mortality among patients at Kaiser Permanente's San Diego Health Appraisal Clinic. After completing a medical evaluation, patients were mailed the ACE questionnaire. Overall, the response rate was 70.5%, with surveys obtained for 9,508 clinic patients. The questionnaire assessed childhood (i.e., before the age of 18) exposure to physical, sexual, and verbal/emotional abuse; emotional and physical neglect; household member substance abuse, incarceration, and mental illness; and domestic violence in the household. Results showed that 52% of respondents had experienced one or more adversities during childhood, with 6.2% reporting four or more. Significant relationships were established between ACEs and a number of medical conditions including heart disease, cancer, stroke, diabetes, emphysema, skeletal fractures, hepatitis, and self-reported fair or poor health. Significant associations between ACEs and health-risk behaviors including smoking, obesity, sedentary lifestyle, alcoholism, use of illicit drugs, intravenous drug use, and fifty or more intercourse partners were also reported.

Since its development, the ACE survey has been used to further examine associations between childhood adversity and diverse health outcomes. However, research describing associations between ACEs, health outcomes, and risk factors among forensic and inpatient mental health populations have been very limited, despite a plethora of evidence that these populations are disproportionally exposed to childhood abuse and household dysfunction

(Baglivio et al., 2014; Dierkhising et al., 2013; Rytilä-Manninen et al., 2014). No published studies to date have examined these relationships using ACE methodology in a forensic inpatient mental health setting.

Childhood Trauma and Physical Health

Previous literature has clearly linked childhood trauma and household dysfunction to a variety of physical health outcomes including heart disease, chronic bronchitis or emphysema, diabetes, hepatitis or jaundice, cancer, COPD, stroke, asthma, chronic headaches, chronic pain, irritable bowel syndrome, fibromyalgia, and sleep disturbances and disorders (Anda et al., 2008; Anda, Tietjen, Schulman, Felitti & Croft, 2010; Campbell, Walker, & Egede, 2016; Felitti et al., 1998; Gilbert et al., 2015; Kajeepeta, Gelaye, Jackson, & Williams, 2015; Springer, Sheridan, Kuo, & Carnes, 2003). A number of theories attempt to describe the relationship between childhood trauma and poor health outcomes (for review see Krause, Shaw, & Cairney, 2004; Springer et al., 2003). One theory relates childhood trauma to a poor sense of mastery and self-control, which is in turn related to negative health outcomes (Brown & Harris, 1978; Mirowsky & Ross, 2002). An additional theory postulates that childhood trauma is linked to chronic illness through difficulties maintaining close personal relationships (Bowlby, 1980; Krause, 2001). Specifically, research has shown that individuals exposed to sexual abuse in childhood experience greater difficulties with romantic or intimate relationships (Fleming, Mullen, Sibthorpe, & Bammer, 1999), and quality of social support has been subsequently linked to a variety of health outcomes (Kawachi & Berkman, 2001; Walen & Lachman, 2000). Other models, however, relate childhood adversity and physical health through direct physiological alterations that can occur following a traumatic event. For instance, McEwen and Lasley (2002) have established a relationship between trauma exposure and compromised immune functioning.

A final theory proposes that childhood abuse and chronic health conditions are related through the adoption of health-risk behaviors, as individuals exposed to abuse as children are more likely to report risky health behaviors such as smoking, substance abuse, and obesity, all of which have been associated with a variety of adult health conditions that will be further described below (Draper et al., 2008).

Cardiovascular disease. Numerous studies have linked adverse childhood experiences to heart disease and heart attacks (Campbell et al., 2016; Felitti et al., 1998; Gilbert et al., 2015; Scott et al., 2016). Scott et al. (2011) found that childhood adversity increased the risk of heart disease development, with those being exposed to two (*HR*= 1.55; 95% CI [1.19, 2.03]) and three or more ACEs (*HR*=2.19; 95% CI [1.59, 3.01]) being 55% and 119% more likely to report later heart disease, respectively. An additional study found that participants reporting seven, eight, or nine ACEs were nearly four times more likely (*AOR*=3.8; 95% CI [1.9, 7.8]) to be diagnosed with heart disease in comparison with those with an ACE score of zero (Gilbert et al., 2015). After adjusting for demographic variables (i.e., age, race, gender, marital and employment status, region of residence, income, and educational attainment), an additional study of 48,526 participants spanning five states found that persons with two ACEs were 1.39 times more likely to be diagnosed with coronary heart disease than those with an ACE score of zero (*AOR*=1.39; 95% CI [1.04, 1.86]) (Campbell et al., 2016). Similarly, an individual with a score of four or higher was 1.86 and 1.63 times more likely to experience a heart attack (*AOR*=1.86; 95% CI [1.33, 2.60]) or be diagnosed with coronary heart disease (*AOR*=1.63; 95% CI [1.17, 2.27]), respectively, than an individual with no ACEs (Campbell et al., 2016). Several studies have also examined the risk of heart disease by specific type of ACE. Draper et al. (2008) found a significant relationship between risk of cardiovascular disease, including heart attack, and

childhood physical and sexual abuse, while Campbell et al. (2016) found childhood verbal abuse significantly increased a participant's risk of coronary heart disease (*AOR*=1.36; 95% CI [1.07, 1.73]).

Diabetes. Like heart disease, diabetes has also been repeatedly linked to previous experiences of childhood adversity (Campbell et al., 2016; Felitti et al., 1998; Gilbert et al., 2015; Scott et al., 2011). For instance, Gilbert et al. (2015) reported that individuals with 1-3 ACEs and 4-6 ACEs were 1.2 times (95% CI [1.1, 1.4]) and 1.4 times (95% CI [1.1, 1.7]) more likely to develop diabetes compared to those with no ACEs. Campbell et al. (2016) reported comparable results, revealing a dose-response relationship between number of ACEs and risk of developing diabetes. While individuals with one ACE were more likely to develop diabetes (*AOR*=1.25; 95% CI [1.05, 1.50]) than those with no ACEs, individuals with two (*AOR*=1.32; 95% CI [1.06, 1.63]), three (*AOR*=1.36; 95% CI [1.06, 1.75]), and four or more (*AOR*=1.39; 95% CI [1.09, 1.77]) were at an even higher risk. Several studies have examined the risk of developing diabetes by type of childhood adversity. Scott et al. (2011) reported that physical abuse, parental divorce, and criminal behavior in the family significantly increased the risk of diabetes in adulthood. Campbell et al. (2016), on the other hand, found that childhood sexual abuse (*AOR*=1.45; 95% CI [1.08, 1.94]) and verbal abuse (*AOR*=1.22; 95% CI [1.01, 1.47]) significantly increased a participant's risk of developing diabetes, more so than other discrete forms of abuse.

Chronic pain. There is also support for a significant association between childhood adversity and subsequent development of chronic pain (Imbierowicz & Egle, 2003; Lampe et al., 2003; Raphael et al., 2001; Scott et al., 2011; Springer et al., 2003). Imbierowicz and Egle (2003) examined rates of childhood adversity among a population of individuals with

fibromyalgia or a somatoform pain disorder. ACE scores were significantly higher among patients with fibromyalgia than in the control group. Rates of domestic violence, sexual abuse, and physical maltreatment in childhood were also significantly higher among fibromyalgia patients, with those in the fibromyalgia group reporting domestic violence seven times more frequently than the control group. An additional study examined rates of childhood abuse among a population of women reporting chronic pelvic pain or chronic low-back pain (Lampe et al., 2003). Results showed that childhood physical abuse occurred significantly more frequently in the two pain groups than for controls, and "very severe" sexual abuse was significantly more frequent among women who reported chronic pelvic pain. Per the results of structural equation modeling, childhood physical abuse significantly impacted later chronic pain, but sexual abuse did not.

Raphael, Chandler, and Ciccone (2004) conducted a literature review investigating the association between childhood abuse and subsequent adult chronic pain. Five studies examined undifferentiated childhood abuse and found participants with a history of childhood abuse reported increased pain prevalence and pain in a greater number of bodily locations in comparison with those without a history of abuse. Seven of thirteen case-control studies, and five of six cross-sectional studies that examined childhood sexual abuse and adult pain disorders reported higher rates of childhood sexual abuse in pain cases. Seven of twelve studies describing associations between physical abuse in childhood and adult pain also found higher rates of abuse among those with pain disorders. Only two cross-sectional studies examined physical abuse, with one reporting a significant association when abuse was reported as "frequent." Scott et al. (2011) also reported that risk of chronic back or neck pain and frequent or severe headache increased significantly with additional ACE exposures. Individuals exposed to three or more

ACEs were 59% more likely to report chronic back or neck pain (*HR*=1.59; 95% CI [1.36, 1.82]) and 63% more likely to report frequent or severe headache (*HR*=1.63; 95% CI [1.37, 1.95]) than those with no ACEs. Scott et al. (2011) also examined associations between individual types of childhood adversity and chronic pain. Physical abuse, sexual abuse, neglect, parental mental illness, parental substance abuse, violence and criminal behavior in the family each increased the risk of adult chronic back or neck pain and frequent or severe headache. Parental divorce also increased the risk of back or neck pain, but not headache.

Cancer. While there is significant research on the associations between childhood adversity and cardiovascular disease, diabetes, and chronic pain, there are fewer studies examining the impact of ACEs on cancer specifically. Available research reveals inconsistencies in the association between cancer and childhood adversity. Felitti et al. (1998) reported that while having three ACEs did not increase the risk of cancer compared to individuals with no ACEs, having one or two ACEs increased the risk by 20%, while having four or more increased the risk by 90% after controlling for age, gender, educational attainment, and race. A study by Brown et al. (2010) examined the association between ACEs and lung cancer status, which was determined using hospital discharge and mortality records denoting lung cancer as the cause of death. Results showed a significant and graded relationship between ACE scores and lung cancer risk. After controlling for age, sex, race, marital status, educational attainment, and financial problems, individuals with four or five ACEs were approximately 88% more likely to develop lung cancer (*RR*=1.88; 95% CI [1.04, 3.41]), while those with six or more ACEs were 2.7 times more likely than those with no ACEs (*RR*=2.70; 95% CI [0.94, 7.72]). Among individuals who died from lung cancer, those with six or more ACEs died approximately 13 years earlier (*M*=62.0 years; 95% CI [53.7, 70.2]) than those with no ACEs (*M*=75.4 years; 95%

CI [73.0, 77.8]). Kelly-Irving and colleagues (2013) also examined the relationship between cancer and ACEs among participants in the National Child Development Study, a fifty-year birth cohort study in Great Britain. Results showed no significant link between ACEs and cancer among male participants, but a significant association was reported for female participants. The prevalence of cancer among females with one ACE or two or more ACEs was 13.0% and 23.0%, respectively, while only 9.1% of women with no ACEs reported cancer. Analyses showed risk of cancer increased by 40% for women with one ACE (*AOR*=1.40; 95% CI [1.06, 1.83]) and nearly 150% for women with two or more ACEs (*AOR*=2.46; 95% CI [1.66, 3.65]), compared to those with none. Few studies report relationships between cancer and individual types of ACEs. However, Fuller-Thompson et al. (2009) reported childhood physical abuse raised odds of cancer by 49% when controlling for age, sex, and race (*OR*=1.49; 95% CI [1.10, 2.01]). Even after controlling for childhood stress (defined as parental divorce, addiction, or unemployment), health behaviors, and socioeconomic status, odds of being diagnosed with cancer were 47% higher for individuals exposed to physical abuse in childhood (*OR*=1.47; 95% CI [1.05, 1.99]).

Health Risk Behaviors

One common theory for the association between ACEs and negative adult health outcomes proposes that the adoption of health-risk behaviors drives this connection. Health-risk behaviors are unhealthy behaviors that significantly impact the development and course of chronic illness (Grantmakers in Health, 2004). In fact, more than half of all deaths in the United States are attributed to such behavioral risk factors (McGinnis & Foege, 1993), including sedentary lifestyle, cigarette smoking, poor diet, high-risk sexual activity, shared use of needles, and excessive alcohol consumption (Schneiderman, 2004). Tobacco use is the most common preventable cause of death, followed by poor diet and physical inactivity (Schneiderman, 2004).

It has been estimated that these three factors in combination lead to approximately 800,000 deaths annually (Grantmakers in Health, 2004; American Cancer Society, 2014). The United States Centers for Disease Control and Prevention (CDC) estimates that by eliminating poor diet, sedentary lifestyle, and smoking, 80% of heart disease and stroke cases, 80% of type 2 diabetes cases, and 40% of cancer instances could be prevented (Partnership to Fight Chronic Disease, no date).

There is evidence that individuals exposed to abuse during childhood are at increased risk of engaging in unhealthy behaviors in adolescence and adulthood (Draper et al., 2008), likely in an attempt to cope with the distress associated with childhood adversity. According to Felitti et al. (1998):

> The linking mechanisms [between adverse childhood experiences and adult diseases] appear to center on behaviors such as smoking, alcohol or drug abuse, overeating, or sexual behaviors that may be consciously or unconsciously used because they have immediate pharmacological or psychological benefit as coping devices in the face of the stress of abuse, domestic violence, or other forms of family and household dysfunction" (p. 253).

For this reason, it is important to review the evidence describing links between ACEs and health-risk behaviors.

Smoking. Smoking is the leading cause of preventable death in the U.S. (Walsh, 2014) and has been significantly linked to development of heart disease, cancer, chronic lung conditions, and stroke (U.S. Department of Health & Human Services, 2014) as well as the prognosis of diagnosed chronic diseases. For instance, among individuals who have experienced

a heart attack, smoking cessation can cut the risk of subsequent attacks by half (Ronnevik, Gundersen, & Abrahamsen, 1985).

A strong relationship exists between ACEs and adult smoking status (Anda et al., 1999; Ford et al., 2011; Springer et al., 2003; Walsh, 2014). Felitti (1998) reported that participants with three (*AOR*=2.0; 95% CI [1.5, 2.6]) and four or more ACEs (*AOR*=2.2; 95% CI [1.7, 2.9]) were twice as likely to be current smokers compared to participants with no ACEs. Brown et al. (2010) found that those with three (*OR*=1.60; 95% CI [1.33, 1.93]); four or five (*OR*=1.78; 95% CI [1.49, 2.13]); and six, seven, or eight (*OR*=2.08; 95% CI [1.59, 2.72]) ACEs were 60%, 78%, and 108% more likely to report current smoking, respectively. Campbell et al. (2016) also reported a significant graded relationship between ACE score and current smoking status, with individuals with one ACE being 61% more likely (*AOR*=1.61; 95% CI [1.36, 1.91]) and participants with two ACEs 90% more likely (*AOR*=1.90; 95% CI [1.57, 2.31]) to be smokers than individuals with no ACEs. Individuals with three (*AOR*=2.10; 95% CI [1.68, 2.64]) and four or more ACEs (*AOR*=2.70; 95% CI [2.24, 3.24]) were more than twice as likely to report current smoking, which is consistent with previous findings (e.g., Felitti, 1998). Individual types of childhood adversity, including sexual abuse, verbal abuse, substance abuse within the home, and parental separation or divorce also significantly increase the odds of adult smoking (Campbell et al., 2016).

ACEs have also been significantly associated with early smoking initiation, ever smoking, and heavy smoking (Anda et al., 1999), demonstrating the same graded relationship between ACE score and these specific smoking variables. Individuals reporting six or more ACEs were more than three times as likely to report ever smoking, and more than twice as likely to report heavy smoking compared to individuals with no ACEs (Brown et al., 2010). Odds of

early smoking initiation (i.e., regular smoking behavior by age 14) were perhaps the most staggering (Brown et al., 2010). An ACE score of one increased risk of early smoking by more than 50% (*OR*=1.53; 95% CI [1.26, 1.87]); while participants reporting six or more ACEs were more than seven times as likely as those with no ACEs to report early smoking initiation (*OR*=7.06; 95% CI [5.27, 9.45]).

Substance abuse. In addition to smoking, substance abuse and dependence have also been linked to a variety of negative health outcomes and studies have provided evidence that childhood adversity can increase the risk of later substance abuse. Alcohol abuse and dependence have been associated with a number of poor health outcomes, including cardiovascular issues such as hypertension and stroke, liver disease, and various types of cancer (National Institute on Alcohol Abuse and Alcoholism, 2016). Excessive consumption of alcohol additionally weakens the body's overall immune response, making disease development more likely. Numerous studies have consistently demonstrated significant associations between ACEs and alcohol abuse and dependence (Anda et al., 2002; Dube et al., 2006; Felitti et al., 1998; Kessler, Davis, & Kendler, 1997; Pilowsky, Keyes, & Hasin, 2009; Pilowsky & Wu, 2006; Springer et al., 2003). Pilowsky et al. (2009), for example, found that one (*OR*=1.51; 95% CI [1.37, 1.65]) or two or more ACEs (*OR*=1.53; 95% CI [1.26, 1.86]) increased the odds of alcohol dependence by 51% and 53%, respectively. Among a population of adult members of Kaiser Permanente Medical Care Program, Strine et al. (2012) reported the following were significantly associated with alcohol problems in adult women: emotional, physical, and sexual abuse; emotional and physical neglect; household drug use and mental illness; and parental separation or divorce in childhood. Physical and sexual abuse, emotional neglect, parental incarceration,

household mental illness, and household drug use during childhood were also associated with alcohol problems in adult men.

Among a population of female inmates, women exposed to neglect in childhood - but not physical or sexual abuse - were significantly more likely to endorse alcohol-related problems later in life (Widom, Ireland, & Glynn, 1995). Mullings, Hartley, and Marquart (2004) also examined the relationship between alcohol use and childhood adversity in a population of female prisoners. Alcohol-dependent participants were more likely to report parental substance abuse, physical abuse, sexual abuse, and other indicators of childhood dysfunction, including having unmet physical needs, feeling unsafe, and lacking shelter, food, and adequate clothing during childhood in comparison with non-alcohol-dependent participants. Further analyses suggested that childhood neglect, but not physical or sexual abuse, was significantly associated with adult alcohol dependence. Messina and Grella (2006) also used ACE survey methodology to examine the association between various childhood traumatic events and various health outcomes among female parolees in a prison-based substance abuse program. Results again illustrated a significant relationship between childhood adversities and alcohol-related problems.

Use of illicit substances like narcotics or other illegal drugs also increases health risks and is related to health conditions including cancer, HIV/AIDS, hepatitis, stroke, cardiovascular disease, and lung disease (National Institute on Drug Abuse, 2012). While fewer studies have examined the association between ACEs and drug abuse, there is evidence that a significant relationship exists (Dube et al., 2003; Felitti et al., 1998; Springer et al., 2003).

Early ACE research established a significant association between ACEs and both illicit drug use and intravenous drug use (Felitti et al., 1998), with individuals reporting four or more ACEs being more than four times as likely to report ever using illicit drugs (*AOR*=4.7; 95% CI

[3.7, 6.0]) and more than ten times as likely to report injecting drugs (*AOR*= 10.3, 95% CI [4.9, 21.4]) as those with no ACEs. Wu, Schairer, Dellor, and Grella (2010) reported that with each additional ACE exposure, the likelihood of injection drug use increased by 17% among a population of individuals with comorbid mental health and substance abuse disorders. Zlotnick, Tam, and Robertson (2004) reported that within a homeless population, those reporting childhood adversity were significantly more likely to report heavy drug use compared to those with no ACEs (78.4% vs. 55.1%). Another study reported that for each instance of violent crime or abuse a person was exposed to in childhood, the odds of being substance dependent (either alcohol or drug dependence) nearly doubled (Douglas et al., 2010), after controlling for demographic factors. Substance use in the household during childhood also doubled the risk of being a substance dependent adult. Finally, a study of Hispanic individuals in Southern California found that ACEs significantly increased the probability of marijuana and hard drug use in the prior month (Allem, Soto, Baezconde-Garbanati, & Unger, 2015).

Friestad, Ase-Bente, and Kjelsberg (2014) also examined the relationship between ACEs and drug abuse among a population of female prisoners. Drug abuse was defined as using an illegal drug within four weeks prior to the current period of incarceration and/or having been drunk at least weekly in the last year. After controlling for age, immigrant background, and marital status, regression analyses showed that the number of ACEs significantly increased the risk of substance abuse. For each additional ACE, the risk of drug abuse increased by 25%.

Obesity. Like smoking, alcohol, and substance abuse, diet and physical activity have significant implications for the prevention and prognosis of chronic disease. Poor diet has been associated with hypertension, high cholesterol, and obesity (Center for the Advancement of Health, 2000) as well as coronary heart disease, stroke, type 2 diabetes, and some types of cancer

(HHS, 2000) while sedentary lifestyle has been identified as one of the top risk factors for development of cardiovascular disease (Prasad & Das, 2009), nearly doubling one's risk (HHS, 1996). Good nutrition and regular physical activity have been shown to reduce the risk of cardiovascular disease, osteoporosis, stroke, diabetes, and some types of cancer (Blair & Brodney, 1999; CDC, 2003; Fang, Wylie-Rosett, Cohen, Kaplan, & Alderman, 2003; Gotay, 2005; Kriska et al., 2003).

Bellis, Lowey, Leckenby, Hughes, and Harrison (2013) examined the association between ACE score and obesity. While a BMI of thirty or more (indicating obesity) was significantly associated with ACE scores in bivariate analyses, the relationship was no longer significant after accounting for demographic variables. However, morbid obesity (or a BMI of forty or more) was significantly associated with ACE scores, even after accounting for demographic factors. Individuals exposed to four or more ACEs were three times more likely to report a body mass index of forty or more compared to those without ACEs (*AOR*=3.02; 95% CI [1.38, 6.62]). Danese and Tan (2014) conducted a meta-analysis examining the association between childhood maltreatment (i.e., abuse, neglect, and family violence) and obesity risk. This meta-analysis of 41 studies found childhood maltreatment significantly increased the risk of obesity (*OR*=1.36; 95% CI [1.26, 1.47]), but included studies examining obesity risk in both childhood and adulthood. Campbell et al. (2016) also examined associations between health conditions and health-risk behaviors, cumulative ACE score, and individual types of childhood adversity. While associations between ACE scores and obesity failed to reach significance, childhood sexual abuse significantly increased the risk of adult obesity by 59% (*AOR*=1.59; 95% CI [1.31, 1.92]).

While ACEs have been associated with the adoption of health-risk behaviors, are these behaviors in fact responsible for later development of chronic illness? There is some evidence that health-risk behaviors mediate the relationship between childhood abuse and adult health outcomes, but only partially. For instance, Chartier and Walker (2009) found smoking, alcohol problems, and obesity were partial mediators of the associations between childhood physical and sexual abuse and various adult health outcomes including poor self-rated health, disability, high health professional or emergency department utilization, and comorbid health problems. However, this study did not use ACE methodology and examined only childhood physical and sexual abuse. Additionally, health outcomes were defined broadly and specific diagnoses were not examined. Thus, further research is needed to better understand the role of health-risk behaviors in the relationship between childhood adversity and adult chronic illness.

Adverse Childhood Experiences in Forensic Mental Health Patients

While a large number of studies have examined ACEs and their association with health conditions and health-risk behaviors, these studies have primarily been conducted in community samples. Few studies have been conducted in forensic or psychiatric populations despite evidence that individuals in these populations are disproportionally exposed to childhood trauma and household dysfunction (Baglivio et al., 2014; Dierkhising et al., 2013; Rytilä-Manninen et al., 2014). It is thus possible that forensic mental health patients may also experience disproportionate long-term health risks as a result.

Inmate populations and childhood adversity. Much of the evidence describing rates of childhood adversity in forensic samples have come primarily from inmate populations or other offender samples. Among a sample of female inmates in substance abuse treatment in California, more than 40% of the women endorsed sexual abuse, family violence, and parental

separation or divorce during childhood, with only 15.7% reporting no childhood adversities and 31.8% reporting four or more (Messina & Grella, 2006). An additional examination of childhood adversity using modified ACE survey variables in a sample of 742 inmates (Messina, Grella, Burdon, & Prendergast, 2007) noted that nearly half of the sample reported parental substance abuse and family violence during childhood. Further, participants reported high rates of cumulative childhood adversity (e.g., 30.7% reported four or more categories of adversity), and very few (12.9%) indicated no occurrences of childhood abuse, neglect, or familial dysfunction.

Levenson, Willis, and Prescott (2015) also used ACE survey methodology to examine childhood adversity among a population of female sex offenders. Rates of no ACEs in this population were much lower (20% vs. 35%) while rates of four or more ACEs were much higher (41% vs. 15%) compared to the general female population as measured in a large-scale study conducted by the Centers for Disease Control and Prevention (CDC; Centers for Disease Control and Prevention, 2016b). These female offenders were also four times more likely to have been exposed to verbal/emotional abuse and three times more likely to have experienced to sexual abuse, emotional neglect, and have an incarcerated family member during childhood compared to the CDC's community female sample. Levenson, Willis, & Prescott (2014) reported similar results in a population of male sex offenders. Male offenders were less likely to report no ACEs than the national comparison sample, with only 16% reporting no childhood adversities, while nearly half of the sample reported having four or more ACEs. Male offenders were significantly more likely than males in the CDC community sample to endorse each of the ten adverse childhood experiences. Male offenders were nearly 14 times more likely to report verbal abuse, six times more likely to report parental incarceration, and four times more likely to report

emotional neglect and parental divorce as compared to male participants in the CDC community sample.

Other examinations of ACEs among offender populations have involved juvenile offenders. Young offenders in Japanese adolescent correctional facilities have reported more serious adverse childhood experiences compared to gender- and age-matched non-offender comparison groups (Matsuura, Hashimoto, & Toichi, 2009; Matsuura & Toichi, 2007). One study reported rates of childhood adversity in Japanese female juvenile offenders and compared them to a group of first-year female high school students in the same geographical area (Matsuura, Hashimoto, & Toichi, 2013). Significant differences in ACE scores were reported between the offender and control group, with offenders being 37 times more likely to report four or more ACEs compared to control subjects (*OR*=37.6; 95% CI [8.4, 166.8]). Individuals in the juvenile offender sample were also 52 times more likely to experience recurrent physical abuse (*OR*=52.7; 95% CI [12.1, 230.5]), 18 times more likely to experience substance abuse within the home (*OR*=18.4; 95% CI [6.6, 50.8]), and eight times more likely to report recurrent emotional abuse (*OR*=8.4; 95% CI [3.7, 19.0]) than the comparison group. They were also 19 times more likely to report domestic violence (*OR*=19.6; 95% CI [5.5, 70.3]), 15 times more likely to experience neglect (*OR*=15.5; 95% CI [3.2, 74.6]), and six times more likely to endorse parental mental illness (*OR*=6.0; 95% CI [2.8, 12.8]) during childhood compared to the non-offender sample. An additional study examining ACEs in a juvenile offender population found ACE prevalence rates to be three times higher than in national comparison groups (Baglivio et al., 2014). This same study also indicated that juvenile offenders were 13 times less likely to report no ACEs, but four times more likely to report four or more ACEs than those in a national comparison sample.

Psychiatric populations and childhood adversity. Several studies have also provided data on rates of childhood adversity within inpatient psychiatric populations and among individuals with severe and persistent mental illness. Shack, Averill, Kopecky, Krajewski, and Gummattira (2004) examined the prevalence of childhood physical and sexual abuse among inpatient psychiatric hospital patients. Overall, 40.6% of males and 70.3% of females reported some form of physical or sexual abuse, with 17.5% of male patients and 45.9% of female patients experiencing both types. However, these rates describe abuse that had occurred during both childhood and adulthood. Spidel, Lecomte, Greaves, Sahlstrom, & Yuille (2010) also reported rates of various childhood adversities among those with early onset psychosis. The overall child abuse mean score, as measured by the Childhood Trauma Questionnaire (Bernstein et al., 1994) fell into the severe to extreme range, with 90% reporting emotional abuse, 61% endorsing physical abuse, and 40% reporting sexual abuse during childhood.

Other estimated rates of trauma and maltreatment among individuals diagnosed with severe mental illness vary greatly from 19.2% to 89% (Husted, Ahmed, Chow, Brzustowicz, & Bassett, 2010; Subica, Claypoole, & Wylie, 2012). Read et al. (2005) conducted a review of studies examining the link between childhood trauma and adult psychosis and reported a weighted average of 69% of individuals with psychosis who endorsed childhood physical or sexual abuse. Morgan and Fisher (2007) conducted a similar review but reported a weighted average of 50% of individuals with psychosis who experienced sexual or physical abuse during childhood.

Forensic mental health populations and childhood adversity. While research has examined rates of ACEs in forensic and inpatient mental health populations independently, no known studies to date have examined the prevalence of ACEs and their relationship to chronic

health outcomes within an inpatient forensic mental health population. However, several studies have suggested the presence of high levels of trauma within such a population. For example, Swanson et al. (2002) reported that persons diagnosed with severe mental illness who reported physical or sexual trauma during childhood were three times more likely to have engaged in recent violence than controls. An additional study also examined the association between childhood adversity and recent aggression among individuals with early onset psychosis (Spidel et al., 2010). Results showed that both physical and verbal aggression were significantly predicted by experiences of childhood abuse. Similarly, Bruce and Laporte (2015) found that inpatient males with severe mental illness who also endorsed childhood trauma were significantly more likely to have committed violent acts in their lifetime, and were 2.8 times more likely to report recent violence.

Chronic Health Conditions and Forensic/SMI Populations

Given the increased rates of ACEs in forensic and inpatient mental health populations, it is not surprising that there is evidence that chronic illnesses are more prevalent within incarcerated populations than the general population (Baillargeon, Black, Pulvino, & Dunn, 2000; Wilper et al., 2009). One study reported that 38.5% of federal prisoners, 42.8% of state prisoners, and 38.7% of local jail inmates suffered from at least one chronic medical condition (Wilper et al., 2009). Binswanger, Krueger, and Steiner (2009) examined rates of medical conditions among 6,582 jail and 14,373 prison inmates and compared rates to non-institutionalized adults. Results showed that inmates had significantly higher odds of hypertension, stroke, asthma, arthritis, diabetes, and cervical cancer compared to the general population. In an additional study of 759 offenders entering a maximum-security prison, 17.4% had a cardiovascular condition, 5.1% carried a diagnosis of diabetes, and 1.7% reported having

cancer (Bai, Befus, Mukherjee, Lowy, & Larson, 2015). This sample also reported high rates of health-risk behaviors, with 34.7% classified as obese and 64.4% being smokers. Substance abuse was also prevalent, with 39.0% having used cocaine, 16.1% having used heroin, and 8.8% having used intravenous drugs.

Similar to incarcerated populations, individuals with serious mental illness (SMI) also experience higher rates of physical illness and have a reduced life expectancy compared to individuals without SMI (Robson & Gray, 2007). Jones et al. (2004) reported that rates of diabetes and heart disease were higher in two samples of Medicaid enrollees with serious mental illness than in a national comparison sample. However, exact rates of difference between the SMI samples varied. In their review of the literature on physical health and serious mental illness, Robson and Gray (2007) noted that studies have consistently established that individuals with SMI were at increased risk of developing cardiovascular disease, respiratory disease, certain types of cancer, diabetes, and HIV. Similarly, De Hert et al. (2011) conducted a thorough review of studies examining medical conditions among individuals with SMI and found that persons with severe mental illness were more likely to be diagnosed with diabetes, cardiovascular diseases, tuberculosis, pneumonia, chronic obstructive pulmonary disease (COPD), and osteoporosis. Several reviewed studies also significantly linked severe mental illness and obesity. Unlike the review by Robson and Gray (2007), conclusions regarding the association between SMI and cancer in this review were inconsistent.

Study Overview

Considerable research has established a link between ACEs and chronic illness in community samples. However, no studies to date have examined this relationship within the context of a forensic inpatient mental health setting despite evidence that individuals in these

populations disproportionally endorse childhood adversity and chronic health problems compared to the general population. Given the high level of risk associated with this population, it is important to examine this relationship within this setting. While ACEs may continue to be associated with chronic disease among forensic inpatient populations, it is also possible that due to the stressors often faced by those with high ACE scores, other factors may be associated with development of chronic illness in adulthood in this population. In order to provide effective prevention services, causal factors within this population need to be better understood.

This study will use a subset of existing data collected in the context of a larger study to achieve the following aims to address gaps in the literature:

1. Examine cumulative exposure to childhood adversity and exposure to individual types of trauma and maltreatment within a forensic inpatient mental health setting
2. Examine prevalence of chronic illness and health-risk behaviors within a forensic inpatient mental health setting
3. Examine the relationships between childhood adversity, health-risk behaviors, and chronic illnesses in a forensic inpatient mental health setting
4. Examine the collective relationships between childhood adversity, health-risk behaviors, and chronic illnesses in a forensic inpatient mental health setting using mediation analyses

Four hypotheses will be tested in this study:

1. Participants within the sample will be more frequently exposed to multiple childhood adversities and individual types of adversity than participants in a national comparison sample.

2. A significant and positive relationship will exist between ACEs and chronic illness variables.
3. A significant and positive relationship will exist between health-risk behaviors and chronic illness variables.
4. A significant and positive relationship will emerge between ACEs and health-risk behaviors.

CHAPTER 2

METHODS

Setting/Sample

This study examines extant data collected within the context of a larger interdisciplinary study. The research team for this study included a forensic clinical psychologist and an epidemiologist, as well as a number of undergraduate and graduate research assistants.

Data were collected from a forensic psychiatric hospital in the Midwestern United States housing patients at maximum, intermediate, and minimum-level security. Participants in the study were patients in the facility admitted under civil commitment orders or forensic orders later commuted to civil commitment. Inclusion criteria for study eligibility include admission to the facility since 2005, discharge prior to data collection, and residence for a minimum of one year. Of those meeting inclusion criteria, a list of participants was randomly generated. A total of 182 residents' records were reviewed and included within this study. All study methods were approved by the East Tennessee State University Medical IRB and the research committee of the involved facility. Data collection was funded by a Research Development Committee Major Grant from East Tennessee State University.

A majority of the sample was male (80.8%, n=147), consistent with the gender distribution of the facility at that time. A majority of patients were Caucasian (55.5%, n=101), with the remainder African-American (40.1%, n=73), Hispanic (2.2%, n=4), or mixed ethnicity/other (2.2%, n=4). On average, participants were 43.6 years old (SD=13.2 years) at the time data were collected. The average age at admission was 32.5 years (SD=11.6), and 40.5 years (SD=13.2) at discharge. The average length of stay for the most recent admission was 8.0 years (SD=7.1). While a majority of participants were admitted to the facility following displays of aggressive behavior in lower-security facilities (53.3%, n=97), other reasons for admission

include being determined to lack competency to stand trial (20.3%, *n*=37), suicidal or self-harm behavior (2.2%, *n*=4), and pre-trial evaluation (1.6%, *n*=3). Additionally, 11.5% were admitted directly from the department of corrections (*n*=21) and 10.9% were admitted for other or unknown reasons (*n*=20).

Measures

Adverse Childhood Experiences (ACE) Survey. The ACE survey (Felitti et al., 1998; Centers for Disease Control and Prevention, 2016a) is a ten-item measure assessing exposure to various adversities in childhood. Specifically, this survey assesses exposure to emotional abuse, physical abuse, sexual abuse, violence towards the mother, household substance abuse, mental illness in the household, parental separation, incarceration of a household member, emotional neglect, and physical neglect. While study participants did not complete the ACE survey, ACE scores utilized in this study were derived from participants' medical records.

Procedure

Following the selection of participants, a team of three trained research assistants reviewed archival data from each participant's chart including medical, psychiatric, and social services records, family reports, annual review reports, and discharge summaries. Psychiatric diagnoses were reported using the DSM-IV-TR diagnostic codes and were collapsed into categories of disorder type; for example, diagnoses of depression, bipolar disorder, schizoaffective disorder, or other disorders with a mood specifier were categorized as mood disorders, and diagnoses of schizophrenia, schizoaffective disorder, or other disorders with a psychotic component were categorized as psychotic disorders. Medical diagnoses were recorded by specific diagnosis. Presence of a diagnosis was coded dichotomously as absent or present. Among the medical conditions coded from archival records, six met criteria for chronic

conditions and were included in this study. These specific diagnoses include heart disease, diabetes, cancer, hypertension, high cholesterol, and chronic pain. Tobacco, alcohol, and abuse of illicit substances were also recorded dichotomously and were used as health-risk behavior variables within the current study. These include alcohol abuse, smoking, and abuse of marijuana, cocaine, methamphetamine, speed, heroin, hallucinogens, inhalants, and prescription drugs. As data for participants' weight and height were available, a variable for body mass index (BMI) was also calculated used as a health-risk behavior variable.

A participant's ACE score was derived using the items from the ACE survey. Presence of adverse childhood experiences were recorded retrospectively based upon endorsement in various records including documentation of disclosure by the participant during admission or treatment, disclosure by participant family members to facility staff, and review of other agencies' records included in the participant's file. Experiencing a childhood adversity was recorded dichotomously as present or absent, and then scores were totaled for the ACE score, which ranges from 0-9. While the original ACE survey assessed ten items, facility charts did not consistently distinguish between physical and emotional neglect, thus the two categories were collapsed into one.

Data Analysis Plan

Aim one. The study's first aim was to examine cumulative exposure to childhood adversity and exposure to individual types of adversity within a forensic inpatient mental health population. To achieve this aim, frequencies and descriptive statistics were used. Specifically, rates of cumulative ACE scores as well as endorsement of particular childhood adversities (e.g., physical abuse, neglect, parent incarceration) were reported. A mean ACE score for the overall

sample and mean ACE scores for groups endorsing each examined chronic illness were also calculated.

Aim two. The study's second aim was to examine the prevalence of chronic illness and health-risk behaviors within a forensic inpatient mental health setting. To achieve this aim, frequencies and descriptive statistics were again used. Specifically, prevalence of any chronic illness, heart disease, diabetes, cancer, hypertension, high cholesterol, and chronic pain were reported. Additionally, rates of smoking, alcohol abuse, illicit drug abuse, and obesity were calculated.

Aim three. The study's third aim was to examine the relationship between childhood adversity, chronic illness, and health-risk behaviors within a forensic inpatient mental health setting. Three direct pathways were analyzed: the association between childhood adversity and chronic illness variables, childhood adversity and health-risk behaviors, and chronic illness variables and health-risk behaviors. Childhood adversity was measured using the total ACE score (0-9). Chronic illness was examined in each analysis in three ways: dichotomously (any chronic illness diagnosis vs. no chronic diagnosis), number of chronic illnesses (0-6), and incidence of individual diagnoses (each diagnosis examined dichotomously). Finally, health-risk behaviors included incidence of individual health-risk behaviors. While smoking and substance abuse variables were examined dichotomously, obesity was analyzedusing body mass index (BMI) scores. Age, gender, and race served as covariates in each analysis, as prior research has established links between each of these variables and prevalence of chronic illness (Paez, Zhao, & Hwant, 2009). Specifically, those over age 64 are most likely to report comorbid chronic illnesses and least likely to reported no chronic diseases. Additionally, females, non-Hispanics,

and Caucasians report more chronic conditions than males, Hispanics, and black or other races, respectively.

To assess the relationship between childhood adversity and chronic illness variables, both logistic and Poisson regression analyses were used. Specifically, logistic regression was used to examine the relationship between ACE scores and presence of any chronic illness and presence of the six particular chronic diseases diagnoses. Poisson regression analyses were used to examine the association between ACE scores and number of chronic conditions.

To test the relationship between childhood adversity and health-risk behaviors, logistic and linear regression analyses were used. Linear regression was used to study the relationship between ACE scores and BMI, while logistic regression was used to examine the relationship between ACE scores and individual types of substance abuse (e.g., smoking, alcohol abuse, heroin abuse).

Finally, to examine the relationship between chronic illness variables and health-risk behaviors, regression analyses was again used. Poisson regression was used to assess the relationship between health-risk behavior variables and number of chronic illnesses. Logistic regression was used to examine the association between risk behaviors and presence of any chronic illness and presence of each of the six examined chronic conditions. Therefore, a total of eight regression analyses were completed for each health-risk behavior, with the health-risk behavior serving as the independent variable.

Aim four. The study's final aim was to collectively examine the association between the three variables of interest: ACE scores, health-risk behaviors, and chronic illness variables using mediation analyses. Pathways to mediation were examined and the significance of indirect effects was tested using bootstrapping. Age, gender, and race served as covariates, ACE score

served as the independent variable, and health-risk behaviors served as mediators. The initial data analysis plan was to conduct a total of eight mediation analyses with dependent variables including number of chronic illnesses, presence of any chronic illness, and presence of the six examined chronic disease diagnoses. However, as only one direct relationship between ACE scores and chronic illness variables emerged as significant, only one mediation analysis was conducted.

CHAPTER 3

RESULTS

Demographics

A total of 182 participants were included in the study. Approximately 81% of the sample was male (*n*=147) and a majority identified as Caucasian (55.5%, *n*=101). An additional 40.1% identified as black (*n*=73), 2.2% as Hispanic *(n*=4), and 2.2% as mixed or other ethnicity (*n*=4). The average age at time of admission to the facility was 32.5 years (*SD*=11.6 years) and the mean age at discharge was 40.5 years (*SD*=12.7 years).

Aim One

The first aim of this study was to examine cumulative exposure to childhood adversity as well as exposure to individual types of adversity. Of the study sample, 17% were exposed to no ACEs (*n*=31), 18.7% exposed to one ACE (*n*=34), 14.3% exposed to two ACEs (*n*=26), 9.3% three ACEs (*n*=17), and 24.6% four or more ACEs (*n*=45). Specifically, 3.8% of the sample were exposed to four ACEs (*n*=7), 11.0% five ACEs (*n*=20), 6.0% six ACEs (*n*=11), and 3.8% seven ACEs (*n*=7).

Endorsement of childhood abuse was prevalent within the sample, with 35.7% exposed to physical abuse (*n*=65), 24.2% emotional abuse (*n*=44), and 33.0% sexual abuse (*n*=60). Childhood neglect occurred in 17.6% of the sample (*n*=32). Nearly half of the sample came from a home where parents were divorced, separated, or not married (49.5%, *n*=90), and 19.2% experienced domestic violence in their home (*n*=35). Just over one-quarter of the sample reported a parent with mental illness (25.3%, *n*=46) and 32.4% experienced parental substance abuse (*n*=59). Finally, just over five percent of the sample had an incarcerated parent (5.5%, *n*=10).

The mean ACE score for the overall sample was 2.48 (*SD*=2.14) while the mean score for those with one or more chronic illnesses was 2.41 (*SD*=2.19). Among those with chronic conditions, those with high cholesterol (*M*= 2.68, *SD*=2.39) and hypertension (*M*= 2.52, *SD*=2.16) had the highest average ACE score followed by those with diabetes (*M*= 2.14, *SD*=2.01), chronic pain (*M*= 1.82, *SD*=1.90), cardiac conditions (*M*= 1.68, *SD*=1.34), and cancer (*M*= 1.2, *SD*=0.84).

Aim Two

The study's second aim was to examine the prevalence of chronic illness and health-risk behaviors within an inpatient forensic setting.

Chronic illness was frequent in the sample, with the mean (*M*=1.44, *SD*=1.26) and modal (27.5%, *n*=50) number of chronic illnesses being one. Slightly under one-quarter of the sample had no chronic illness diagnoses (23.1%, *n*=42). Approximately 17% were diagnosed with two chronic conditions (16.5%, *n*=30), followed by three (13.7%, *n*=25), four (3.8%, *n*=7), five (0.5%, *n*=1), and six conditions (0.5%, *n*=1).

Of the six assessed chronic conditions (heart disease, diabetes, cancer, hypertension, high cholesterol, and chronic pain), hypertension was the most frequent diagnosis with nearly half of the sample carrying this diagnosis (49.5%, *n*=90). High cholesterol was also frequent, with 30.2% (*n*=55) of the sample diagnosed. Additionally, 20.9% were diagnosed with chronic pain (*n*=38), 16.5% with diabetes (*n*=30), 11.5% with heart disease (*n*=21), and 3.3% with cancer (*n*=6).

Health-risk behaviors were also frequently endorsed within the sample. Most the sample reported alcohol abuse (58.8%, *n*=107) and had a body mass index in the overweight or obese category (overweight: 30.2%, *n*=55; obese: 26.9%, *n*=49), with an average BMI of 29.3 within

the sample. A history of marijuana use was reported by nearly half of the sample (48.9%, n=89) while tobacco smoking was endorsed by 35.7% (n=65) of the sample. A history of cocaine (26.9%, n=49) and hallucinogen abuse (17.6%, n=32) were also common. Reports of abuse of heroin (9.9%, n=18), methamphetamine (9.3%, n=17), prescription drugs (7.7%, n=14), inhalants (6.6%, n=12), and speed (5.5%, n=10) were less common.

Aim Three

The study's third aim was to examine the relationship between childhood adversity, chronic illness, and health-risk behaviors through three direct pathways: the associations between childhood adversity and chronic illness, childhood adversity and health-risk behavior, and chronic illness and health-risk behavior. Results regarding the "cancer" variable should be interpreted with caution, as few participants endorsed this diagnosis (n=6; 3.3%).

Childhood adversity and chronic illness. Logistic and Poisson regression analyses were used to assess the relationships between ACE scores and chronic illness variables. All analyses controlled for age, gender, and race. Race and gender were coded as dummy variables (i.e., Caucasian and other race; male and female). Caucasian race and female gender served as reference groups and are thus not reported in tables. For all analyses, demographic variables were entered in step one and ACE scores were entered in step two. Results for analyses can be viewed in Table 1.

ACE and presence of any chronic illness. A logistic regression was performed to ascertain the effects of ACE scores on presence of any of the six examined chronic illnesses. While the overall logistic regression model was statistically significant ($x^2(4)=15.044$, $p<.01$), this was driven by demographic variables, as the addition of ACE scores to the model in step two failed to reach significance ($x^2(1)=0.377$, $p=.539$). The overall model explained 14.0%

(Nagelkerke R^2) of the variance in a chronic illness diagnosis. In examining individual predictor variables, increasing age was associated with increased risk of chronic illness diagnosis (*OR*=1.064; 95% CI [1.027, 1.102]). All other variables failed be significantly associated with chronic illness status.

ACE and number of chronic illnesses. Poisson regression was utilized to assess the relationship between ACE scores and number of chronic illnesses. While the overall model emerged as significant ($x^2(4)=43.100$, $p<.001$), this was driven by the age variable ($x^2(1)=40.473$, $p<.001$) as gender, race, and ACE variables failed to reach significance. Full results can be viewed in Table 1.

Table 1

Demographic variables, ACE scores, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.039	.0061	[.027, .051]	40.473	.000
Male	-.024	.1834	[-.384, .335]	.017	.895
Non-White	.189	.1478	[-.101, .478]	1.631	.202
ACE	.067	.0401	[-.011, .146]	2.824	.093

ACE and individual chronic illnesses. To examine the relationships between ACE scores and specific chronic illnesses, logistic regression analyses were used. Results can be seen in Table 2.

The regression model examining the association between ACE and high cholesterol emerged as statistically significant ($x^2(4)=13.297$, $p<.05$) and explained 12.5% (Nagelkerke R^2) of the variance in presence of high cholesterol. Both age (OR=1.056; 95% CI [1.021, 1.092]) and ACE score (*OR*=1.265; 95% CI [1.022, 1.566]) were significantly and positively associated

with high cholesterol diagnosis while other variables failed to contribute significantly to the model.

The logistic regression model assessing the relationship between ACE scores and diabetes was statistically significant ($x^2(4)=16.849$, $p<.01$), but only demographic variables were significantly associated with diabetes. Both age (*OR*=1.067; 95% CI [1.025, 1.110]) and non-white race (*OR*=3.615; 95% CI [1.398, 9.353]) were positively associated with a diagnosis of diabetes. The model explained 17.6% (Nagelkerke R^2) of the variance in diabetes diagnosis.

Models assessing relationships between ACE scores and any chronic illness ($x^2(4)=15.044$, $p<.01$), cardiac diagnoses ($x^2(4)=11.323$, $p<.05$), hypertension ($x^2(4)=10.781$, $p<.05$), and chronic pain ($x^2(4)=12.003$, $p<.05$) were also statistically significant, but only age was significantly associated with increased risk of diagnosis (any chronic illness *OR*=1.064; 95% CI [1.027, 1.102]; cardiac *OR*=1.064; 95% CI [1.017, 1.114]; hypertension (*OR*=1.047; 95% CI [1.017, 1.078]); chronic pain (*OR*=1.044; 95% CI [1.009, 1.080]). While the relationship between ACE scores and cancer diagnosis ($x^2(4)=12.553$, $p<.05$) was statistically significant, no predictor variables were significantly associated with cancer diagnosis in the overall model.

Table 2

Demographic variables, ACE scores, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.062	.018	11.828	.001	1.064	[1.027, 1.102]
Male	-.115	.528	.047	.828	.892	[.317, 2.510]
Non-White	-.123	.404	.092	.761	.885	[.401, 1.952]
ACE	.063	.104	.373	.541	1.066	[.869, 1.306]
Cardiac condition						
Age	.062	.023	7.284	.007	1.064	[1.017, 1.114]

Table 2 (continued)

	B	S.E.	Wald	*P*	OR	95% CI
Male	-.158	.669	.056	.813	.854	[.230, 3.166]
Non-White	.141	.542	.068	.794	1.152	[.398, 3.330]
ACE	-.042	.156	.074	.786	.959	[.706, 1.301]
Hypertension						
Age	.046	.015	9.496	.002	1.047	[1.017, 1.078]
Male	.021	.446	.002	.963	1.021	[.426, 2.446]
Non-White	.005	.355	.000	.989	1.005	[.501, 2.014]
ACE	.145	.094	2.383	.123	1.156	[.962, 1.390]
High Cholesterol						
Age	.054	.017	9.847	.002	1.056	[1.021, 1.092]
Male	.495	.514	.926	.336	1.640	[.599, 4.495]
Non-White	-.296	.411	.520	.471	.743	[.332, 1.665]
ACE	.235	.109	4.647	.031	1.265	[1.022, 1.566]
Diabetes						
Age	.065	.021	9.875	.002	1.067	[1.025, 1.110]
Male	.419	.647	.420	.517	1.520	[.428, 5.399]
Non-White	1.285	.485	7.024	.008	3.615	[1.398, 9.353]
ACE	.158	.130	1.481	.224	1.171	[.908, 1.510]
Cancer						
Age	.076	.054	1.958	.162	1.079	[.970, 1.199]
Male	-.672	1.049	.411	.521	.510	[.065, 3.987]
Non-White	-17.989	4724.587	.000	.997	.000	[.000]
ACE	-.173	.381	.205	.650	.842	[.399, 1.775]
Chronic pain						
Age	.043	.017	6.116	.013	1.044	[1.009, 1.080]
Male	-.371	.524	.501	.479	.690	[.247, 1.928]
Non-White	-.179	.430	.173	.677	.836	[.360, 1.943]
ACE	-.099	.119	.701	.402	.906	[.718, 1.142]

Childhood adversity and health-risk behaviors. Both logistic and linear regression analyses were used to assess the relationships between ACE scores and health-risk behaviors. All analyses controlled for age, gender, and race. In each analysis, demographic variables were entered in step one and ACE score was entered in step two.

ACE and body mass index. Linear regression was performed to ascertain the effects of ACE scores on body mass index. The demographic only regression model was statistically

significant and predicted 24.7% of the variance in body mass index (R^2=.247, F (1, 103)=8.79 p<.001). However, the addition of ACE score to the model failed to reach significance and no additional variance in BMI was explained with the addition of ACE to the model (ΔR^2=.000).

Table 3

Demographic variables, ACE scores, and body mass index via linear regression

	B	S.E. (B)	β	t	p	95% CI
Age	-.068	.035	-.181	-1.941	.055	[-.138, .001]
Male	-5.394	1.121	-.432	-4.810	.000	[-7.618, -3.170]
Non-White	-1.012	.926	-.097	-1.093	.277	[-2.849, .825]
ACE	.043	.231	.018	.188	.851	[-.416, .502]

ACE and substance abuse. Logistic regression was used to assess relationships between ACE scores and smoking and abuse of alcohol, marijuana, crack/cocaine, hallucinogens, prescription drugs, speed, methamphetamine, heroin, and inhalants. Results can be viewed in Table 4.

Statistically significant results emerged between ACEs and smoking (x^2(4)=11.863, p<.05, Nagelkerke R^2=.108) and abuse of alcohol (x^2(4)=18.484, p<.01, Nagelkerke R^2=.157), marijuana (x^2(4)=15.078, p<.01, Nagelkerke R^2=.133), crack/cocaine (x^2(4)=18.259, p<.01, Nagelkerke R^2=.170), methamphetamine (x^2(4)=12.371, p<.05, Nagelkerke R^2=.167), hallucinogens (x^2(4)=14.058, p<.01, Nagelkerke R^2=.148), and prescription drugs (x^2(4)=13.000, p<.05, Nagelkerke R^2=.197).

Examination of individual predictors within these models showed that age was significantly associated with smoking (β=.042, p<.01, OR=1.043), alcohol abuse (β=.044, p<.01, OR=1.045), crack/cocaine abuse (β=.051, p<.01, OR=1.052), and hallucinogen abuse (β=.049, p<.05, OR=1.050). Male gender emerged as a significant predictor for alcohol (β=1.097, p<.05,

OR=2.994) and marijuana abuse (*β*=1.282, *p*<.05, *OR*=3.605). Non-Caucasian race was a significant predictor of cocaine abuse (*β*=1.152, *p*<.01, *OR*=3.165) and the association between marijuana and race approached significance (*β*=.699, *p*=.057, *OR*=2.012). Finally, ACE scores were significantly and positively associated with smoking status (β=.293, p<.01, *OR*=1.341), alcohol abuse (*β*=.352, *p*<.01, *OR*=1.422), marijuana abuse (*β*=.273, *p*<.01, *OR*=1.314), crack/cocaine abuse (*β*=.352, *p*<.01, *OR*=1.422), methamphetamine abuse (*β*=.509, *p*<.01, *OR*=1.664), hallucinogen abuse (*β*=.432, *p*<.01, *OR*=1.540), and prescription drug abuse (*β*=.595, *p*<.01, *OR*=1.813).

Models examining relationships between ACE scores and abuse of speed (x^2(4)=8.222, *p*=.084, Nagelkerke R^2=.171), heroin (x^2(4)=8.919, *p*=.063, Nagelkerke R^2=.119), and inhalants (x^2(4)=6.766, *p*=.149, Nagelkerke R^2=.131), failed to reach significance. While overall models did not reach significance, the addition of ACEs in the second step of regression was significantly and positively associated with speed abuse (x^2(1)=5.795, *p*<.05; *β*=.518, *p*<.05), heroin abuse (x^2(1)=4.323, *p*<.05; *β*=.312, *p*<.05), and inhalant abuse (x^2(1)=4.838, *p*<.05; *β*=.438, *p*<.05).

Table 4

Demographic variables, ACE scores, and health-risk behavior outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Smoking						
Age	.042	.016	7.301	.007	1.043	[1.012, 1.076]
Male	.306	.477	.411	.522	1.358	[.533, 3.462]
Non-White	.041	.378	.012	.913	1.042	[.497, 2.185]
ACE	.293	.102	8.193	.004	1.341	[1.097, 1.639]
Alcohol abuse						
Age	.044	.015	8.283	.004	1.045	[1.014, 1.078]
Male	1.097	.474	5.355	.021	2.994	[1.183, 7.578]

Table 4 (continued)

	B	S.E.	Wald	*P*	OR	95% CI
Non-White	.623	.381	2.674	.102	1.864	[.884, 3.932]
ACE	.352	.106	10.996	.001	1.422	[1.155, 1.752]
Marijuana abuse						
Age	.015	.015	1.106	.293	1.015	[.987, 1.045]
Male	1.282	.500	6.579	.010	3.605	[1.353, 9.605]
Non-White	.699	.367	3.624	.057	2.012	[.980, 4.130]
ACE	.273	.102	7.118	.008	1.314	[1.075, 1.605]
Cocaine abuse						
Age	.051	.018	8.155	.004	1.052	[1.016, 1.089]
Male	.505	.549	.846	.358	1.657	[.565, 4.863]
Non-White	1.152	.420	7.527	.006	3.165	[1.390, 7.210]
ACE	.352	.115	9.301	.002	1.422	[1.134, 1.782]
Meth abuse						
Age	.034	.025	1.806	.179	1.035	[.985, 1.087]
Male	1.505	.872	2.978	.084	4.503	[.815, 24.876]
Non-White	-.334	.608	.301	.583	.716	[.218, 2.357]
ACE	.509	.165	9.547	.002	1.664	[1.205, 2.298]
Speed abuse						
Age	.064	.038	2.773	.096	1.066	[.989, 1.150]
Male	-.516	.902	.328	.567	.597	[.102, 3.493]
Non-White	.392	.837	.219	.640	1.480	[.287, 7.630]
ACE	.518	.228	5.160	.023	1.679	[1.074, 2.625]
Heroin abuse						
Age	.060	.025	5.862	.015	1.062	[1.012, 1.115]
Male	-.328	.642	.261	.609	.720	[.205, 2.535]
Non-White	.208	.580	.002	.961	1.029	[.330, 3.205]
ACE	.312	.152	4.200	.040	1.366	[1.014, 1.841]
Hallucinogen abuse						
Age	.049	.020	5.854	.016	1.050	[1.009, 1.092]
Male	.408	.594	.473	.492	1.504	[.470, 4.818]
Non-White	.540	.468	1.335	.248	1.716	[.686, 4.291]
ACE	.432	.129	11.199	.001	1.540	[1.196, 1.983]
Inhalant abuse						
Age	.022	.033	.474	.491	1.023	[.959, 1.090]
Male	1.374	1.152	1.423	.233	3.951	[.413, 37.750]
Non-White	-.769	.856	.807	.369	.463	[.086, 2.482]
ACE	.438	.206	4.529	.033	1.549	[1.035, 2.318]
Rx drug abuse						
Age	.038	.029	1.705	.192	1.039	[.981, 1.100]
Male	.530	.792	.448	.503	1.699	[.360, 8.021]
Non-White	-.245	.675	.131	.717	.783	[.209, 2.940]
ACE	.595	.187	10.163	.001	1.813	[1.257, 2.613]

Health-risk behaviors and chronic illness. Both logistic and linear regression analyses were used to assess the relationships between ACE scores and health-risk behaviors. All analyses controlled for age, gender, and race. In each analysis, demographic variables were entered in step one and health-risk behaviors were entered in step two. A total of eight regression analyses were completed for each health-risk behavior (associations with any chronic illness, number of chronic illnesses, and individual chronic diagnoses), with the health-risk behavior serving as the independent variable.

Smoking. The association between smoking and number of chronic illnesses was assessed using Poisson regression. The overall model emerged as significant (Likelihood ratio $x^2(4)=39.011$, $p<.001$), with age ($x^2(1)=32.124$, $p<.001$) and smoking status ($x^2(1)=3.961$, $p<.05$) being significantly associated with number of chronic illnesses. Poisson results can be viewed in Table 5. The models assessing relationships between smoking and cardiac conditions ($x^2(4)=11.201$, $p<.05$, Nagelkerke $R^2=.126$), hypertension ($x^2(4)=9.477$, $p=.05$, Nagelkerke $R^2=.077$), high cholesterol ($x^2(4)=13.581$, $p<.01$, Nagelkerke $R^2=.116$), diabetes ($x^2(4)=16.059$, $p<.01$, Nagelkerke $R^2=.159$), cancer ($x^2(4)=9.526$, $p<.05$, Nagelkerke $R^2=.214$), chronic pain ($x^2(4)=12.982$, $p<.05$, Nagelkerke $R^2=.120$), and any chronic illness ($x^2(4)=15.475$, $p<.01$, Nagelkerke $R^2=.137$) emerged as statistically significant.

Smoking as an individual predictor within these models showed a significant relationship with high cholesterol ($\beta=1.046$, $p<.01$, $OR=2.846$) and presence of any chronic illness ($\beta=.829$, $p<.05$, $OR=2.290$). Smoking as an individual predictor failed to reach significance in other models, and significance was instead accounted for by demographic variables. Full results can be viewed in Table 6.

Table 5

Demographic variables, smoking, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.029	.0052	[.019, .039]	32.124	.000
Male	.142	.1683	[-.187, .472]	.715	.398
Non-White	.169	.1429	[-.111, .449]	1.404	.236
Smoking	.271	.1361	[.004, .537]	3.961	.047

Table 6

Demographic variables, smoking, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.046	.016	8.500	.004	1.048	[1.015, 1.081]
Male	-.226	.499	.205	.651	.798	[.300, 2.120]
Non-White	-.014	.391	.001	.972	.986	[.459, 2.121]
Smoking	.829	.420	3.887	.049	2.290	[1.005, 5.218]
Cardiac condition						
Age	.059	.019	9.602	.002	1.061	[1.022, 1.101]
Male	-.303	.602	.254	.614	.738	[.227, 2.401]
Non-White	.096	.512	.035	.852	1.100	[.403, 3.003]
Smoking	-.423	.514	.678	.410	.655	[.239, 1.794]
Hypertension						
Age	.032	.013	6.715	.010	1.033	[1.008, 1.059]
Male	.023	.416	.003	.955	1.024	[.453, 2.315]
Non-White	-.091	.336	.074	.786	.913	[.473, 1.762]
Smoking	.404	.334	1.466	.226	1.498	[.779, 2.883]
High Cholesterol						
Age	.025	.014	3.328	.068	1.025	[.998, 1.053]
Male	.158	.468	.115	.735	1.172	[.468, 2.932]
Non-White	-.168	.376	.200	.655	.845	[.1.767]
Smoking	1.046	.362	8.331	.004	2.846	[1.399, 5.788]
Diabetes						
Age	.053	.017	9.512	.002	1.055	[1.020, 1.091]
Male	.228	.619	.136	.712	1.257	[.374, 4.225]
Non-White	1.147	.471	5.921	.015	3.149	[1.250, 7.934]
Smoking	.026	.444	.003	.954	1.026	[.429, 2.451]
Cancer						
Age	.075	.037	4.041	.044	1.078	[1.002, 1.160]

Table 6 (continued)

	B	S.E.	Wald	*P*	OR	95% CI
Male	-.528	.982	.289	.591	.590	[.086, 4.041]
Non-White	-1.137	1.173	.941	.332	.321	[.032, 3.194]
Smoking	1.097	.919	1.425	.233	2.996	[.494, 18.156]
Chronic pain						
Age	.048	.015	10.205	.001	1.050	[1.019, 1.081]
Male	-.600	.477	1.584	.208	.549	[.215, 1.397]
Non-White	-.152	.415	.135	.714	.859	[.381, 1.936]
Smoking	-.110	.407	.073	.787	.896	[.403, 1.989]

Alcohol abuse. The association between alcohol abuse and number of chronic illnesses was assessed using Poisson regression (Table 7). While the overall model emerged as significant (Likelihood ratio $x^2(4)=36.427$, $p<.001$), only age ($x^2(1)=33.110$, $p<.001$) was significantly associated with number of chronic illnesses. The models examining the relationships between alcohol abuse and cardiac conditions ($x^2(4)=11.536$, $p<.05$, Nagelkerke $R^2=.127$), diabetes ($x^2(4)=17.413$, $p<.01$, Nagelkerke $R^2=.169$), chronic pain ($x^2(4)=13.507$, $p<.01$, Nagelkerke $R^2=.120$), and any chronic illness ($x^2(4)=12.763$, $p<.05$, Nagelkerke $R^2=.108$) were statistically significant. However, as an individual predictor within these models, alcohol abuse failed to reach significance. Models examining the relationships between alcohol abuse and hypertension, high cholesterol, and cancer conditions failed to reach significance. Full results from logistic analyses can be seen in Table 8.

Table 7

Demographic variables, alcohol abuse, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.029	.0051	[.019, .040]	33.110	.000
Male	.161	.1699	[-.172, .494]	.899	.343
Non-White	.136	.1429	[-.144, .416]	.909	.340
Alcohol	.135	.1493	[-.157, .428]	.821	.365

Table 8

Demographic variables, alcohol abuse, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.041	.016	6.958	.008	1.042	[1.011, 1.075]
Male	-.502	.495	1.028	.311	.605	[.229, 1.598]
Non-White	-.152	.382	.158	.691	.859	[.406, 1.818]
Alcohol	.615	.387	2.527	.112	1.849	[.867, 3.947]
Cardiac condition						
Age	.060	.019	9.708	.002	1.062	[1.023, 1.103]
Male	-.416	.613	.460	.498	.660	[.198, 2.194]
Non-White	.127	.514	.061	.805	1.136	[.414, 3.113]
Alcohol	.195	.530	.135	.714	1.215	[.430, 3.435]
Hypertension						
Age	.030	.012	6.069	.014	1.031	[1.006, 1.056]
Male	-.220	.403	.297	.585	.803	[.365, 1.768]
Non-White	-.101	.326	.097	.756	.904	[.477, 1.712]
Alcohol	.060	.332	.032	.858	1.061	[.554, 2.035]
High Cholesterol						
Age	.021	.013	2.600	.107	1.021	[.996, 1.047]
Male	-.139	.423	.108	.742	.870	[.380, 1.993]
Non-White	-.234	.354	.434	.510	.792	[.395, 1.586]
Alcohol	.127	.360	.125	.724	1.136	[.560, 2.302]
Diabetes						
Age	.055	.017	9.812	.002	1.056	[1.021, 1.093]
Male	.109	.632	.030	.863	1.115	[.323, 3.847]
Non-White	1.135	.476	5.696	.017	3.111	[1.225, 7.901]
Alcohol	.339	.488	.484	.487	1.404	[.540, 3.655]
Cancer						
Age	.078	.037	4.470	.034	1.081	[1.006, 1.161]
Male	-.534	.975	.300	.584	.586	[.087, 3.966]
Non-White	-1.243	1.163	1.143	.285	.289	[.030, 2.818]
Alcohol	.469	.948	.244	.621	1.598	[.249, 10.246]
Chronic pain						
Age	.044	.015	8.533	.003	1.044	[1.014, 1.075]
Male	-.556	.479	1.349	.246	.574	[.225, 1.466]
Non-White	-.338	.411	.677	.411	.713	[.319, 1.595]
Alcohol	.482	.423	1.298	.255	1.619	[.707, 3.710]

Marijuana abuse. The overall Poisson model (Table 9) examining the relationship between marijuana abuse and number of chronic illnesses emerged as significant (Likelihood ratio $x^2(4)=34.012$, $p<.001$). However, only age ($x^2(1)=32.840$, $p<.001$) was significantly associated with number of chronic illnesses. The logistic models examining the relationships between marijuana abuse and cardiac conditions ($x^2(4)=11.419$, $p<.05$, Nagelkerke $R^2=.128$), diabetes ($x^2(4)=17.517$, $p<.01$, Nagelkerke $R^2=.174$), chronic pain ($x^2(4)=11.378$, $p<.05$, Nagelkerke $R^2=.105$) and any chronic illness ($x^2(4)=10.947$, $p<.05$, Nagelkerke $R^2=.096$) were statistically significant. However, marijuana abuse as a predictor variable failed to reach significance and age emerged as the only significant predictor for these models. The models examining relationships between marijuana abuse and hypertension, high cholesterol, and cancer conditions failed to reach significance. See table 10 for full results.

Table 9

Demographic variables, marijuana abuse, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.029	.0051	[.019, .039]	32.840	.000
Male	.178	.1724	[-.160, .516]	1.067	302
Non-White	.132	.1456	[-.154, .417]	.816	.366
Marijuana	.105	.1451	[-.179, .390]	.525	.469

Table 10

Demographic variables, marijuana abuse, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.047	.016	8.923	.003	1.048	[1.016, 1.081]
Male	-.422	.528	.639	.424	.656	[.233, 1.846]

Table 10 (continued)

	B	S.E.	Wald	*P*	OR	95% CI
Non-White	-.078	.386	.041	.839	.925	[.434, 1.969]
Marijuana	.114	.391	.085	.771	1.121	[.521, 2.414]
Cardiac condition						
Age	.061	.019	9.734	.002	1.063	[1.023, 1.104]
Male	-.469	.614	.583	.445	.626	[.188, 2.085]
Non-White	.165	.519	.101	.751	1.179	[.426, 3.264]
Marijuana	.231	.516	.201	.654	1.260	[.458, 3.465]
Hypertension						
Age	.033	.012	7.337	.007	1.034	[1.009, 1.059]
Male	-.038	.425	.008	.928	.962	[.419, 2.212]
Non-White	.131	.333	.154	.695	1.139	[.594, 2.187]
Marijuana	-.279	.333	.703	.402	.756	[.394, 1.453]
High Cholesterol						
Age	.024	.013	3.539	.060	1.024	[.999, 1.050]
Male	.018	.450	.002	.968	1.018	[.422, 2.457]
Non-White	-.224	.358	.392	.531	.799	[.396, 1.612]
Marijuana	.162	.356	.208	.648	1.176	[.586, 2.363]
Diabetes						
Age	.061	.018	11.448	.001	1.063	[1.026, 1.102]
Male	.040	.638	.004	.950	1.041	[.298, 3.634]
Non-White	.886	.478	3.444	.063	2.426	[.952, 6.188]
Marijuana	.607	.480	1.595	.207	1.834	[.716, 4.703]
Cancer						
Age	.080	.038	4.467	.035	1.083	[1.006, 1.167]
Male	-.590	.980	.362	.547	.555	[.081, 3.784]
Non-White	-1.258	1.170	1.157	.282	.284	[.029, 2.812]
Marijuana	.563	.942	.358	.550	1.756	[.277, 11.118]
Chronic pain						
Age	.041	.015	7.843	.005	1.042	[1.012, 1.073]
Male	-.596	.480	1.544	.214	.551	[.215, 1.411]
Non-White	-.377	.416	.821	.365	.686	[.304, 1.550]
Marijuana	.217	.408	.282	.596	1.242	[.558, 2.765]

Cocaine abuse. The overall Poisson model examining the relationship between cocaine/crack abuse and number of chronic illnesses emerged as significant (Likelihood ratio $x^2(4)=36.931$, $p<.001$). However, only age ($x^2(1)=33.394$, $p<.001$) was significantly associated with number of chronic illnesses. The logistic models examining the relationships between

cocaine/crack abuse and cardiac conditions ($x^2(4)=11.385$, $p<.05$, Nagelkerke $R^2=.127$), diabetes ($x^2(4)=15.085$, $p<.01$, Nagelkerke $R^2=.149$), cancer ($x^2(4)=11.713$, $p<.05$, Nagelkerke $R^2=.294$), chronic pain ($x^2(4)=11.274$, $p<.05$, Nagelkerke $R^2=.105$), and any chronic illness ($x^2(4)=9.983$, $p<.05$, Nagelkerke $R^2=.087$) were statistically significant. However, cocaine abuse as a predictor variable failed to reach significance in each of these models. The models examining relationships between cocaine/crack abuse and hypertension and high cholesterol failed to reach significance. Results for analyses can be viewed in Tables 11 and 12.

Table 11

Demographic variables, cocaine abuse, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.030	.0052	[.020, .040]	33.394	.000
Male	.098	.1723	[-.240, .436]	.323	.570
Non-White	.157	.1469	[-.131, .444]	1.137	.286
Cocaine	.057	.1520	[-.241, .355]	.142	.707

Table 12

Demographic variables, cocaine abuse, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.047	.016	8.485	.004	1.048	[1.015, 1.081]
Male	-.265	.494	.288	.592	.767	[.292, 2.019]
Non-White	.042	.383	.012	.913	1.043	[.492, 2.210]
Cocaine	-.127	.427	.088	.766	.881	[.381, 2.035]
Cardiac condition						
Age	.060	.019	9.550	.002	1.061	[1.022, 1.102]
Male	-.431	.602	.513	.474	.650	[.199, 2.116]
Non-White	.136	.525	.067	.796	1.145	[.410, 3.202]
Cocaine	.198	.533	.138	.710	1.219	[.429, 3.464]
Hypertension						
Age	.033	.012	6.783	.009	1.033	[1.008, 1.059]

Table 12 (continued)

	B	S.E.	Wald	*P*	OR	95% CI
Male	-.244	.414	.347	.556	.783	[.348, 1.765]
Non-White	.039	.332	.014	.906	1.040	[.543, 1.994]
Cocaine	-.164	.359	.208	.649	.849	[.420, 1.716]
High Cholesterol						
Age	.020	.013	2.433	.119	1.020	[.995, 1.047]
Male	.013	.440	.001	.976	1.013	[.428, 2.402]
Non-White	-.243	.364	.444	.505	.785	[.384, 1.601]
Cocaine	.237	.382	.384	.536	1.267	[.599, 2.678]
Diabetes						
Age	.055	.017	10.019	.002	1.056	[1.021, 1.093]
Male	.234	.618	.143	.705	1.263	[.376, 4.241]
Non-White	1.020	.476	4.593	.032	2.772	[1.091, 7.043]
Cocaine	.055	.478	.013	.909	1.056	[.414, 2.698]
Cancer						
Age	.131	.055	5.650	.017	1.140	[1.023, 1.270]
Male	.280	1.259	.049	.824	1.323	[.112, 15.615]
Non-White	-1.242	1.278	.945	.331	.289	[.024, 3.533]
Cocaine	1.046	1.109	.889	.346	2.846	[.324, 25.027]
Chronic pain						
Age	.044	.015	8.673	.003	1.045	[1.015, 1.077]
Male	-.480	.484	.987	.321	.619	[.240, 1.596]
Non-White	-.248	.425	.340	.560	.781	[.340, 1.795]
Cocaine	.029	.447	.004	.948	1.029	[.429, 2.472]

Methamphetamine abuse. While the overall Poisson model examining the association between methamphetamine abuse and number of chronic illnesses emerged as significant (Likelihood ratio $x^2(4)=34.987$, $p<.001$), only age ($x^2(1)=34.630$, $p<.001$) was significantly associated with number of chronic illnesses. Logistic models examining the relationships between methamphetamine abuse and cardiac conditions ($x^2(4)=15.593$, $p<.01$, Nagelkerke $R^2=.171$), diabetes ($x^2(4)=15.374$, $p<.01$, Nagelkerke $R^2=.151$), chronic pain ($x^2(4)=11.305$, $p<.05$, Nagelkerke $R^2=.104$), and any chronic illness ($x^2(4)=12.140$, $p<.05$, Nagelkerke $R^2=.105$) were statistically significant. However, only demographic variables emerged as significant predictors within these models. The models examining relationships between methamphetamine

abuse and hypertension, high cholesterol, and cancer conditions failed to reach significance. Full analysis results can be seen in tables 13 and 14.

Table 13

Demographic variables, methamphetamine abuse, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.030	.0051	[.020, .040]	34.630	.000
Male	.099	.1719	[-.238, .436]	.334	.564
Non-White	.171	.1431	[-.109, .452]	1.434	.231
Meth	.053	.2314	[-.400, .507]	.053	.818

Table 14

Demographic variables, methamphetamine abuse, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.046	.016	8.655	.003	1.047	[1.016, 1.080]
Male	-.354	.494	.511	.475	.702	[.266, 1.851]
Non-White	.047	.382	.015	.901	1.048	[.496, 2.215]
Meth	1.014	.792	1.637	.201	2.756	[.583, 13.021]
Cardiac condition						
Age	.060	.019	9.844	.002	1.062	[1.023, 1.102]
Male	-.306	.606	.256	.613	.736	[.225, 2.413]
Non-White	.111	.515	.047	.829	1.118	[.407, 3.067]
Meth	-19.344	100009.311	.000	.998	.000	.000
Hypertension						
Age	.032	.012	6.584	.010	1.032	[1.007, 1.057]
Male	-.179	.409	.190	.663	.837	[.375, 1.866]
Non-White	-.008	.327	.001	.979	.992	[.523, 1.881]
Meth	-.211	.524	.162	.687	.810	[.290, 2.263]
High Cholesterol						
Age	.023	.013	3.193	.074	1.023	[.998, 1.049]
Male	.035	.440	.006	.937	1.035	[.437, 2.454]
Non-White	-.140	.356	.155	.694	.869	[.433, 1.746]
Meth	.578	.542	1.136	.286	1.782	[.616, 5.155]

Table 14 (continued)

	B	S.E.	Wald	*P*	OR	95% CI
Diabetes						
Age	.054	.017	9.946	.002	1.056	[1.021, 1.092]
Male	.193	.620	.097	.756	1.212	[.360, 4.086]
Non-White	1.016	.464	4.784	.029	2.762	[1.111, 6.863]
Meth	.505	.655	.595	.440	1.657	[.459, 5.981]
Cancer						
Age	.076	.037	4.373	.037	1.079	[1.005, 1.159]
Male	-.527	.968	.297	.586	.590	[.089, 3.933]
Non-White	-1.124	1.161	.938	.333	.325	[.033, 3.163]
Meth	.718	1.197	.360	.549	2.050	[.196, 21.419]
Chronic pain						
Age	.045	.015	8.978	.003	1.044	[1.016, 1.077]
Male	-.466	.485	.848	.357	.640	[.247, 1.655]
Non-White	-.233	.417	.313	.576	.792	[.350, 1.794]
Meth	-.029	.708	.002	.968	.972	[.243, 3.892]

Speed abuse. The overall Poisson model examining the association between speed abuse and number of chronic illnesses produced significant results (Likelihood ratio $x^2(4)=35.425$, $p<.001$), but only age ($x^2(1)=34.474$, $p<.001$) was significantly associated with number of chronic illnesses. The logistic models examining the relationships between speed abuse and cardiac conditions ($x^2(4)=11.201$, $p<.05$, Nagelkerke $R^2=.125$), diabetes ($x^2(4)=15.690$, $p<.01$, Nagelkerke $R^2=.155$), chronic pain ($x^2(4)=11.010$, $p<.05$, Nagelkerke $R^2=.102$), and any chronic illness ($x^2(4)=15.728$, $p<.01$, Nagelkerke $R^2=.135$) were statistically significant. Within these models, speed abuse as a predictor failed to reach significance. Models examining relationships between speed abuse and hypertension, high cholesterol, and cancer conditions failed to reach significance. However, while the overall model examining the relationship between speed abuse and high cholesterol failed to reach significance, the addition of speed abuse in the second step of regression was significantly and positively associated with high cholesterol ($x^2(1)=3.981$, $p<.05$; $\beta=1.339$, $p<.05$). Results can be viewed in tables 15 and 16.

Table 15

Demographic variables, speed abuse, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.030	.0052	[.020, .041]	34.474	.000
Male	.096	.1710	[-.240, .431]	.312	.576
Non-White	.168	.1435	[-.113, .449]	1.373	.241
Speed	.184	.2604	[-.326, .694]	.499	.480

Table 16

Demographic variables, speed abuse, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.046	.016	8.391	.004	1.047	[1.015, 1.080]
Male	-.273	.501	.296	.586	.761	[.285, 2.031]
Non-White	.026	.386	.005	.945	1.027	[.482, 2.188]
Speed	20.032	12546.650	.000	.999	500918647.1	.000
Cardiac condition						
Age	.060	.019	9.712	.002	1.062	[1.023, 1.102]
Male	-.401	.602	.445	.505	.669	[.206, 2.177]
Non-White	.185	.514	.130	.719	1.203	[.440, 3.293]
Speed	-.247	1.102	.050	.823	.781	[.090, 6.772]
Hypertension						
Age	.031	.012	6.359	.012	1.032	[1.007, 1.057]
Male	-.151	.410	.136	.712	.860	[.385, 1.921]
Non-White	.004	.329	.000	.991	1.004	[.526, 1.914]
Speed	.267	.674	.157	.692	1.306	[.349, 4.895]
High Cholesterol						
Age	.025	.013	3.446	.063	1.025	[.999, 1.052]
Male	.074	.449	.027	.868	1.077	[.447, 2.597]
Non-White	-.176	.367	.230	.632	.839	[.409, 1.721]
Speed	1.339	.678	3.895	.048	3.815	[1.009, 14.418]
Diabetes						
Age	.055	.017	10.280	.001	1.057	[1.022, 1.093]
Male	.244	.619	.155	.693	1.276	[.380, 4.291]
Non-White	1.054	.468	5.066	.024	2.868	[1.146, 7.179]
Speed	-.816	1.108	.543	.461	.442	[.050, 3.875]
Cancer						
Age	.073	.035	4.392	.036	1.076	[1.005, 1.152]

Table 16 (continued)

	B	S.E.	Wald	*P*	OR	95% CI
Male	-.459	.956	.230	.631	.632	[.097, 4.119]
Non-White	-1.127	1.157	.949	.330	.324	[.034, 3.127]
Speed	-17.783	12841.051	.000	.999	.000	.000
Chronic pain						
Age	.044	.015	8.686	.003	1.045	[1.015, 1.077]
Male	-.441	.483	.833	.361	.644	[.250, 1.658]
Non-White	-.241	.418	.332	.564	.786	[.347, 1.782]
Speed	-.028	.841	.001	.974	.973	[.187, 5.060]

Heroin abuse. The Poisson model examining the association between heroin abuse and number of chronic illnesses produced significant results (Likelihood ratio $x^2(4)=36.285$, $p<.001$), but only age ($x^2(1)=31.743$, $p<.001$) was significantly associated with number of chronic illnesses. The logistic models examining the relationships between heroin abuse and cardiac conditions ($x^2(4)=13.320$, $p<.05$, Nagelkerke $R^2=.147$), diabetes ($x^2(4)=15.448$, $p<.01$, Nagelkerke $R^2=.152$), chronic pain ($x^2(4)=11.410$, $p<.05$, Nagelkerke $R^2=.105$), and any chronic illness ($x^2(4)=18.639$, $p<.01$, Nagelkerke $R^2=.159$) were statistically significant. Within these models, heroin abuse as a predictor failed to reach significance. Models examining relationships between heroin abuse and hypertension, high cholesterol, and cancer conditions failed to reach significance.

Table 17

Demographic variables, heroin abuse, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.029	.0052	[.019, .039]	31.743	.000
Male	.089	.1707	[-.246, .423]	.269	.604
Non-White	.167	.1426	[-.112, .447]	1.372	.242
Heroin	.228	.1916	[-.147, .604]	1.420	.233

Table 18

Demographic variables, heroin abuse, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.041	.016	6.730	.009	1.042	[1.010, 1.075]
Male	-.165	.503	.108	.742	.848	[.316, 2.273]
Non-White	.031	.385	.006	.937	1.031	[.485, 2.191]
Heroin	19.983	9295.173	.000	.998	476814464.1	.000
Cardiac condition						
Age	.057	.020	8.621	.003	1.059	[1.019, 1.101]
Male	-.373	.604	.382	.537	.688	[.211, 2.251]
Non-White	.196	.517	.144	.705	1.217	[.441, 3.353]
Heroin	.901	.621	2.107	.147	2.463	[.729, 8.317]
Hypertension						
Age	.032	.012	6.378	.012	1.032	[1.007, 1.058]
Male	-.088	.415	.045	.832	.916	[.406, 2.068]
Non-White	.052	.330	.025	.875	1.053	[.552, 2.010]
Heroin	.511	.541	.891	.345	1.667	[.577, 4.816]
High Cholesterol						
Age	.022	.013	2.822	.093	1.022	[.996, 1.049]
Male	.176	.453	.152	.697	1.193	[.491, 2.896]
Non-White	-.166	.360	.213	.645	.847	[.419, 1.715]
Heroin	.301	.530	.322	.570	1.351	[.478, 3.822]
Diabetes						
Age	.055	.017	9.951	.002	1.056	[1.021, 1.093]
Male	.260	.617	.178	.673	1.297	[.387, 4.346]
Non-White	1.037	.465	4.979	.026	2.820	[1.134, 7.010]
Heroin	.175	.656	.072	.789	1.192	[.330, 4.309]
Cancer						
Age	.075	.036	4.432	.035	1.078	[1.005, 1.157]
Male	-.451	.952	.224	.636	.637	[.099, 4.118]
Non-White	-1.139	1.155	.972	.324	.320	[.033, 3.082]
Heroin	.128	1.167	.012	.912	1.137	[.115, 11.199]
Chronic pain						
Age	.046	.015	9.060	.003	1.047	[1.016, 1.078]
Male	-.463	.485	.911	.340	.630	[.243, 1.628]
Non-White	-.233	.417	.312	.576	.792	[.350, 1.793]
Heroin	-.205	.633	.104	.747	.815	[.236, 2.818]

Hallucinogen abuse. The Poisson model examining the relationship between hallucinogen abuse and number of chronic illnesses was statistically significant (Likelihood ratio $x^2(4)=34.939$, $p<.001$) but only age ($x^2(1)=34.638$, $p<.001$) was significantly associated with number of chronic illnesses. The logistic models examining the relationships between hallucinogen abuse and cardiac conditions ($x^2(4)=11.806$, $p<.05$, Nagelkerke $R^2=.131$), diabetes ($x^2(4)=14.816$, $p<.01$, Nagelkerke $R^2=.146$), chronic pain ($x^2(4)=11.362$, $p<.05$, Nagelkerke $R^2=.105$), and any chronic illness ($x^2(4)=10.155$, $p<.05$, Nagelkerke $R^2=.088$) were statistically significant. Within these models, hallucinogen abuse as a predictor failed to reach significance. Models examining relationships between hallucinogen abuse and hypertension, high cholesterol, and cancer conditions failed to reach significance.

Table 19

Demographic variables, hallucinogen abuse, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.030	.0051	[.020, .040]	34.638	.000
Male	.095	.1707	[-.240, .429]	.309	.579
Non-White	.169	.1428	[-.110, .449]	1.408	.235
Hallucinogen	-.011	.1738	[-.352, .330]	.004	.950

Table 20

Demographic variables, hallucinogen abuse, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.047	.016	8.591	.003	1.048	[1.016, 1.081]
Male	-.302	.492	.378	.539	.739	[.282, 1.937]
Non-White	.029	.379	.006	.939	1.029	[.489, 2.166]

Table 20 (continued)

	B	S.E.	Wald	*P*	OR	95% CI
Hallucinogen	-.048	.492	.009	.923	.953	[.363, 2.502]
Cardiac condition						
Age	.061	.019	10.152	.001	1.063	[1.024, 1.103]
Male	-.408	.603	.459	.498	.665	[.204, 2.166]
Non-White	.189	.513	.136	.713	1.208	[.442, 3.302]
Hallucinogen	-.432	.677	.407	.523	.649	[.172, 2.448]
Hypertension						
Age	.032	.012	6.618	.010	1.032	[1.008, 1.058]
Male	-.191	.408	.218	.641	.826	[.371, 1.839]
Non-White	-.002	.326	.000	.994	.998	[.526, 1.890]
Hallucinogen	-.111	.409	.074	.786	.895	[.402, 1.993]
High Cholesterol						
Age	.022	.013	3.006	.083	1.023	[.997, 1.049]
Male	.065	.439	.022	.882	1.068	[.451, 2.525]
Non-White	-.152	.355	.183	.669	.859	[.428, 1.724]
Hallucinogen	.354	.420	.709	.400	1.424	[.625, 3.246]
Diabetes						
Age	.054	.017	9.924	.002	1.056	[1.021, 1.092]
Male	.241	.616	.153	.696	1.272	[.381, 4.252]
Non-White	.998	.463	4.651	.031	2.713	[1.095, 6.721]
Hallucinogen	.047	.538	.008	.931	1.048	[.365, 3.010]
Cancer						
Age	.075	.036	4.470	.034	1.078	[1.006, 1.156]
Male	-.451	.955	.224	.636	.637	[.098, 4.136]
Non-White	-1.163	1.156	1.012	.314	.313	[.032, 3.011]
Hallucinogen	-.129	1.146	.013	.911	.879	[.093, 8.312]
Chronic pain						
Age	.045	.015	9.036	.003	1.046	[1.016, 1.078]
Male	-.450	.482	.870	.351	.638	[.248, 1.641]
Non-White	-.230	.417	.305	.581	.794	[.351, 1.798]
Hallucinogen	-.126	.523	.058	.810	.882	[.316, 2.457]

Inhalant abuse. The Poisson model examining the relationship between inhalant abuse and number of chronic illnesses was statistically significant (Likelihood ratio $x^2(4)=35.490$, $p<.001$) but only age ($x^2(1)=33.811$, $p<.001$) was significantly associated with number of chronic illnesses. The logistic models examining the relationships between inhalant abuse and cardiac conditions ($x^2(4)=13.908$, $p<.01$, Nagelkerke $R^2=.154$), diabetes ($x^2(4)=15.049$, $p<.01$,

Nagelkerke R^2=.148), chronic pain (x^2(4)=11.312, p<.05, Nagelkerke R^2=.105), and any chronic illness (x^2(4)=10.281, p<.05, Nagelkerke R^2=.090) were statistically significant. Within these models, inhalant abuse as a predictor failed to reach significance. Models examining relationships between inhalant abuse and hypertension, high cholesterol, and cancer conditions failed to reach significance.

Table 21

Demographic variables, inhalant abuse, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.030	.0051	[.020, .040]	33.811	.000
Male	.080	.1718	[-.256, .417]	.218	.640
Non-White	.147	.1453	[-.137, .432]	1.029	.310
Inhalant	-.250	.3476	[-.931, .431]	.517	.472

Table 22

Demographic variables, inhalant abuse, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.047	.016	8.844	.003	1.048	[1.016, 1.081]
Male	-.244	.495	.242	.623	.784	[.297, 2.068]
Non-White	.018	.385	.002	.962	1.019	[.479, 2.165]
Inhalant	-.248	.735	.114	.735	.780	[.185, 3.294]
Cardiac condition						
Age	.058	.019	9.535	.002	1.060	[1.022, 1.100]
Male	-.300	.605	.246	.620	.741	[.226, 2.425]
Non-White	.047	.516	.008	.927	1.048	[.381, 2.881]
Inhalant	-19.248	12442.875	.000	.999	.000	.000
Hypertension						
Age	.032	.012	6.823	.009	1.033	[1.008, 1.058]
Male	-.108	.415	.068	.794	.897	[.398, 2.022]
Non-White	-.014	.331	.002	.966	.986	[.515, 1.887]
Inhalant	-.311	.646	.231	.631	.733	[.206, 2.603]
High Cholesterol						
Age	.024	.013	3.588	.058	1.025	[.999, 1.051]
Male	.156	.453	.118	.731	1.169	[.481, 2.841]

Table 22 (continued)

	B	S.E.	Wald	*P*	OR	95% CI
Non-White	-.103	.361	.082	.775	.902	[.444, 1.830]
Inhalant	.194	.668	.084	.772	1.214	[.328, 4.497]
Diabetes						
Age	.054	.017	9.934	.002	1.055	[1.021, 1.091]
Male	.271	.619	.191	.662	1.311	[.390, 4.405]
Non-White	.969	.466	4.315	.038	2.634	[1.056, 6.570]
Inhalant	-.518	1.114	.216	.642	.596	[.067, 5.282]
Cancer						
Age	.072	.035	4.249	.039	1.075	[1.004, 1.151]
Male	-.360	.955	.142	.706	.698	[.107, 4.538]
Non-White	-1.250	1.159	1.164	.281	.286	[.030, 2.777]
Inhalant	-17.946	12308.030	.000	.999	.000	.000
Chronic pain						
Age	.045	.015	8.956	.003	1.046	[1.016, 1.078]
Male	-.453	.485	.872	.350	.635	[.245, 1.646]
Non-White	-.225	.425	.281	.596	.799	[.347, 1.835]
Inhalant	.079	.860	.008	.927	1.082	[.201, 5.834]

Prescription drug abuse. The Poisson model examining the relationship between prescription drug abuse and number of chronic illnesses was statistically significant (Likelihood ratio $x^2(4)=34.948$, $p<.001$) but only age ($x^2(1)=34.631$, $p<.001$) was significantly associated with number of chronic illnesses. The logistic models examining the relationships between prescription drug abuse and cardiac conditions ($x^2(4)=11.835$, $p<.05$, Nagelkerke $R^2=.131$), diabetes ($x^2(4)=15.875$, $p<.01$, Nagelkerke $R^2=.156$), chronic pain ($x^2(4)=18.024$, $p<.01$, Nagelkerke $R^2=.164$), and any chronic illness ($x^2(4)=11.205$, $p<.05$, Nagelkerke $R^2=.098$) were statistically significant. Within these models, prescription drug abuse as a predictor failed to reach significance. Models examining relationships between prescription drug abuse and hypertension, high cholesterol, and cancer conditions failed to reach significance.

Table 23

Demographic variables, prescription drug abuse, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.030	.0051	[.020, .040]	34.631	.000
Male	.094	.1709	[-.241, .429]	.302	.582
Non-White	.169	.1427	[-.110, .449]	1.408	.235
Rx drugs	.029	.2468	[-.455, .512]	.014	.907

Table 24

Demographic variables, prescription drug abuse, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.047	.016	8.830	.003	1.048	[1.016, 1.081]
Male	-.214	.498	.185	.667	.807	[.304, 2.141]
Non-White	.067	.382	.031	.860	1.070	[.506, 2.260]
Rx drugs	.810	.808	1.005	.316	2.247	[.461, 10.949]
Cardiac condition						
Age	.060	.019	9.785	.002	1.062	[1.023, 1.102]
Male	-.421	.605	.483	.487	.657	[.201, 2.149]
Non-White	.180	.515	.123	.726	1.198	[.436, 3.286]
Rx drugs	-.684	1.085	.397	.528	.505	[.060, 4.233]
Hypertension						
Age	.034	.012	7.629	.006	1.035	[1.010, 1.060]
Male	-.048	.418	.013	.909	.953	[.420, 2.163]
Non-White	.077	.331	.055	.815	1.080	[.565, 2.065]
Rx drugs	.291	.579	.252	.615	1.338	[.430, 4.162]
High Cholesterol						
Age	.025	.013	3.729	.053	1.026	[1.000, 1.052]
Male	.289	.469	.380	.538	1.335	[.533, 3.345]
Non-White	-.117	.363	.103	.748	.890	[.436, 1.814]
Rx drugs	.655	.579	1.279	.258	1.925	[.619, 5.990]
Diabetes						
Age	.056	.017	10.490	.001	1.057	[1.022, 1.094]
Male	.282	.620	.207	.649	1.326	[.393, 4.473]
Non-White	1.047	.465	5.078	.024	2.849	[1.146, 7.081]

Table 24 (continued)

	B	S.E.	Wald	*P*	OR	95% CI
Rx drugs	.544	.749	.528	.468	1.723	[.397, 7.478]
Cancer						
Age	.071	.035	4.127	.042	1.074	[1.003, 1.150]
Male	-.488	.962	.257	.612	.614	[.093, 4.046]
Non-White	-1.134	1.165	.948	.330	.322	[.033, 3.155]
Rx drugs	-17.764	10653.501	.000	.999	.000	.000
Chronic pain						
Age	.044	.015	8.450	.004	1.045	[1.015, 1.077]
Male	-.550	.498	1.218	.270	.577	[.217, 1.532]
Non-White	-.250	.424	.347	.556	.779	[.339, 1.789]
Rx drugs	-20.030	10810.795	.000	.999	.000	.000

Body mass index. The Poisson model examining the relationship between body mass index and number of chronic illnesses was statistically significant (Likelihood ratio $x^2(4)=21.402$, $p<.001$) but only age ($x^2(1)=21.031$, $p<.001$) was significantly associated with number of chronic illnesses. The logistic models examining the relationships between body mass index and diabetes ($x^2(4)=15.837$, $p<.01$, Nagelkerke $R^2=.201$) and chronic pain ($x^2(4)=11.640$, $p<.05$, Nagelkerke $R^2=.140$) were statistically significant. In these models, however, only demographic variables were statistically significant. The models examining relationships between body mass index and cardiac conditions, high cholesterol, hypertension, cancer, and any chronic condition failed to reach significance. However, while the overall model examining the relationship between body mass index and high cholesterol failed to reach significance, the addition of BMI in the second step of regression was significantly and positively associated with high cholesterol ($x^2(1)=4.245$, $p<.05$; $\beta=.086$, $p<.05$). Results can be viewed in tables 25 and 26.

Table 25

Demographic variables, body mass index, and number of chronic illnesses via Poisson regression

	B	S.E.	95% Wald CI	Wald	*P*
Age	.026	.0057	[.015, .037]	21.031	.000
Male	-.032	.2080	[-.440, .376]	.024	.878
Non-White	.158	.1605	[-.156, .473]	.971	.324
BMI	.018	.0162	[-.014, .050]	1.211	.093

Table 26

Demographic variables, body mass index, and chronic illness outcomes via logistic regression

	B	S.E.	Wald	*P*	OR	95% CI
Any chronic illness						
Age	.040	.019	4.610	.032	1.041	[1.003, 1.079]
Male	.436	.613	.505	.477	1.546	[.465, 5.142]
Non-White	.024	.471	.003	.959	1.025	[.407, 2.579]
BMI	.055	.049	1.251	.263	1.056	[.960, 1.163]
Cardiac condition						
Age	.057	.021	7.486	.006	1.059	[1.016, 1.103]
Male	.236	.742	.101	.751	1.266	[.295, 5.423]
Non-White	.155	.568	.074	.785	1.167	[.384, 3.551]
BMI	.061	.057	1.171	.279	1.063	[.951, 1.188]
Hypertension						
Age	.037	.014	6.641	.010	1.038	[1.009, 1.068]
Male	.406	.526	.596	.440	1.501	[.535, 4.212]
Non-White	-.116	.389	.089	.766	.890	[.415, 1.909]
BMI	.068	.041	2.765	.096	1.070	[.988, 1.159]
High Cholesterol						
Age	.024	.014	2.838	.092	1.025	[.996, 1.054]
Male	.719	.563	1.632	.201	2.053	[.681, 6.188]
Non-White	-.362	.412	.774	.379	.696	[.311, 1.560]
BMI	.086	.043	4.044	.044	1.090	[1.002, 1.185]
Diabetes						
Age	.061	.020	9.348	.002	1.063	[1.022, 1.106]
Male	.812	.785	1.071	.301	2.253	[.484, 10.495]
Non-White	1.182	.554	4.547	.033	3.260	[1.100, 9.661]
BMI	.075	.055	1.842	.175	1.078	[.967, 1.200]
Cancer						

Table 26 (continued)

	B	S.E.	Wald	*P*	OR	95% CI
Age	.027	.048	.315	.575	1.027	[.935, 1.129]
Male	-18.490	3820.085	.000	.996	.000	.000
Non-White	-16.176	4473.394	.000	.997	.000	.000
BMI	-.099	.141	.492	.483	.906	[.686, 1.195]
Chronic pain						
Age	.049	.017	8.302	.004	1.051	[1.016, 1.087]
Male	-.676	.608	1.238	.266	.508	[.154, 1.674]
Non-White	-.169	.481	.124	.725	.844	[.329, 2.168]
BMI	-.029	.049	.361	.548	.971	[.883, 1.068]

Aim Four

The final aim of this study was to test the overall model of associations between ACE scores, health-risk behaviors, and chronic illness using mediation analyses, with ACE score serving as the independent variable, health-risk behaviors as mediating variables, and chronic illness variables as dependent variables. As a total of eleven health-risk variables were of interest in this study, principal components analysis was used to reduce the number of mediating variables prior to completing mediation analyses.

Eleven health-risk behaviors were subjected to factor analysis using principal component analysis. The Kaiser-Meyer-Olkin measure of sampling adequacy was .775 and Bartlett's test of sphericity was statistically significant ($x^2(55)=304.03$, $p<.001$). The analysis yielded three factors, explaining a total of 55.81% of the variance for the set of variables. Factor 1 (Eigenvalue= 3.62) explained 32.93% of the variance and was composed of the following variables: abuse of alcohol, marijuana, crack/cocaine, methamphetamine, speed, heroin, hallucinogen, inhalants, and prescription drugs. Thus, factor one was labeled "substance abuse." Factor 2 (Eigenvalue= 1.38) explained an additional 12.53%, with a primary factor loading of .70 for body mass index variable and was labeled "BMI". Finally, factor 3 (Eigenvalue= 1.14)

explained an additional 10.35% of the variance in the variable set, with a primary factor loading of -.51 for the smoking variable and was thus labeled "smoking."

Factor scores were saved to the data set and computed to principal component coefficients. This was completed by multiplying factor scores by the square root of the corresponding Eigenvalue (Cornish, 2007). These values were then saved into new variables and used in the mediation analyses.

Table 27

Factor Loadings Based on Principal Components Analysis for 11 Health-risk Behaviors

Variable	Substance Abuse	BMI	Smoking
Smoking	.443	-.201	**-.505**
Alcohol Abuse	**.734**	.269	-.454
Marijuana Abuse	**.740**	.255	-.353
Crack/Cocaine Abuse	**.684**	.405	.091
Meth Abuse	**.473**	-.391	-.107
Speed Abuse	**.541**	**-.554**	-.027
Heroin Abuse	**.463**	.173	.290
Hallucinogen Abuse	**.715**	-.035	.323
Inhalant Abuse	**.566**	-.220	.389
Rx Drug Abuse	**.553**	.046	.433
Obesity (BMI>30)	-.064	**.703**	.062

The fourth aim of this study was to examine the collective relationship between childhood adversity, health-risk behaviors, and chronic illnesses in an inpatient forensic setting using mediation analyses. According to Baron and Kenny (1986), "a given variable may be said to function as a mediator to the extent that it accounts for the relation between the predictor and the criterion" (p. 1176). They go on to note that for a variable to be a mediator three conditions must be met, including, "when paths *a* and *b* are controlled, a previously significant relation between the independent and dependent variables is no longer significant" (p.1176). Given that direct relationships between the dependent variable (ACE score) and seven of the independent

variables (any chronic illness, number of chronic illnesses, cardiac condition, hypertension, diabetes, cancer, and chronic pain) failed to reach significance, mediation analyses were not conducted for these variables. Since a significant direct relationship emerged between ACE score and high cholesterol, a mediation analysis was performed for this relationship.

For the purposes of the current study, mediation analyses utilized a bootstrap method (Preacher & Hayes, 2008). Specifically, the pathways to mediation were examined and the significance of indirect effects were tested using bootstrapping. Age, gender, and race served as covariates in the mediation analysis, ACE score served as the independent variable, and the principal components variables extracted from principal component analysis served as mediators. High cholesterol served as the dependent variable.

A logistic model was used to examine the mediating role of health-risk behaviors in the relationship between ACE score and high cholesterol diagnosis. Only one path, a path for substance abuse (b=0.2687, SE=0.0980, p<.01), emerged as significant. Current age also emerged as significant and positively related to high cholesterol (b=0.0513, SE=0.0208, p<.05). Approximately 16% of the variance in high cholesterol was accounted for by predictors (Nagelkerke R^2=.1565). Indirect effects were tested using bootstrap estimation approach with 5000 samples (Preacher & Hayes, 2008). Results indicate the indirect effects for all mediators collectively and individual mediators failed to reach significance.

Table 28

Mediation Analyses Examining High Cholesterol from ACE and Health-risk Behaviors

	Coefficient	SE	T	Z	P	Wald's
Effect of ACE on Substance Abuse (a_1)	.2687**	.0980	2.7425	--	.0074	--
Effect of Substance Abuse on Presence of High Cholesterol (b_1)	-.0849	.1420	--	-.5983	.5496	.3580
Effect of ACE on BMI (a_2)	-.0180	.0646	-.2793	--	.7807	--
Effect of BMI on Presence of High Cholesterol (b_2)	.1288	.2182	--	.5904	.5549	.3486
Effect of ACE on Smoking (a_3)	-.0366	.0564	-.6496	--	.5176	--

Table 28 (continued)

	Coefficient	SE	T	Z	P	Wald's
Effect of Smoking on Presence of High Cholesterol (b_3)	-.1174	.2440	--	-.4810	.6305	.2314
Total Effect of ACE on Presence of High Cholesterol (c)	.2313	.1335	--	1.7331	.0831	3.0037
Direct Effect of ACE on Presence of High Cholesterol (c')	.2610	.1411	--	1.8503	.0643	3.4234
Partial Effect Current Age on Presence of High Cholesterol	.0513*	.0208	--	2.4681	.0136	6.0914
Partial Effect Gender on Presence of High Cholesterol	1.1457	.7066	--	1.6213	.1049	2.6287
Partial Effect Race on Presence of High Cholesterol	-.1472	.3533	--	-.4167	.6769	.1737

*$p < .05$. **$p < .01$

CHAPTER 4

DISCUSSION

This study evaluated the presence of Adverse Childhood Experiences (ACEs) and the relationships between ACEs, chronic health conditions, and health-risk behaviors in an inpatient forensic mental health sample. Previous research has established a significant link between ACEs and chronic illnesses in adulthood in a range of community samples. However, prior to this study, this relationship had not been examined within an inpatient forensic mental health setting despite evidence that this population experiences higher rates of both ACEs and chronic illnesses compared to the general public.

Extant data collected as part of a larger interdisciplinary project were used for this study. Participants included patients in a forensic psychiatric hospital who were admitted under civil commitment or forensic orders that were later commuted to civil commitment. As part of the larger interdisciplinary team, three trained research assistants reviewed archival data for a randomly generated list of individuals meeting inclusion criteria. Record review included medical, psychiatric, and social services records, annual review reports, and discharge summaries.

Aim One: Prevalence of Adverse Childhood Experiences

The first aim of this study was to examine cumulative exposure to ACEs as well as exposure to individual types of ACEs within an inpatient forensic mental health setting. While much research has shown high rates of trauma within these populations independently, no known studies to date have provided data using ACE survey methodology to identify cumulative ACEs or impacts of ACEs on specific health outcomes in inpatient forensic mental health settings. It

was hypothesized that study participants would report higher rates of both cumulative and individual ACE exposure than national comparison samples.

The average ACE score for the sample was 2.48, with nearly one-quarter of the sample reporting four or more ACEs and only 17% reporting no ACEs. Rates of individual ACE exposures were also high. Nearly half of the sample reported childhood homes in which parents were divorced, separated, or not married. Physical abuse, sexual abuse, and parental substance abuse were endorsed by approximately one-third of the sample, with emotional abuse and parental mental illness being endorsed by one-quarter of the sample. Childhood neglect and household domestic violence were reported by nearly one-fifth of the sample. Approximately five percent reported having an incarcerated parent during childhood.

How do these numbers compare with national data? The Centers for Disease Control collaborated with Kaiser-Permanente to conduct a large-scale national study of Adverse Childhood Experiences, which included over 17,000 HMO members in southern California receiving physical exams who elected to participate in the study (CDC, 2016a). ACE scores of zero and one were much more prevalent among this CDC sample than the present study's sample, while rates of four or more ACEs were much higher in the current study sample. Additionally, across all individual ACEs, prevalence was higher in the present study sample compared to the CDC comparison group (see Table 29). Thus, data support the first study hypothesis. However, it should be noted that samples were not matched, thus statistical comparisons cannot be made.

Table 29

Sample ACE Data vs. CDC ACE Data

ACE	Study	CDC Comparison
ACE Score		
Zero	17.0%	36.0%
One	18.7%	46.0%
Two	14.3%	15.9%
Three	9.3%	9.5%
Four+	24.6%	12.5%
ACE Category		
Physical Abuse	35.7%	28.3%
Emotional Abuse	24.2%	10.6%
Sexual Abuse	33.0%	20.7%
Neglect	17.6%	Emotional= 14.8% Physical= 9.9%
Parent Divorce/Separation	49.5%	23.3%
Parent Mental Illness	25.3%	19.4%
Parent Substance Abuse	32.4%	26.9%
Parent Incarceration	5.5%	4.7%
Domestic Violence	19.2%	12.7%

While no studies to date have used ACE methodology within a forensic psychiatric population, several studies have examined rates of childhood trauma and adversity within psychiatric and forensic populations independently. For instance, Spidel et al. (2010) examined rates of childhood abuse among a sample of individuals with early psychosis and reported that 90% reported a history of emotional abuse, 61% reported physical abuse, and 40% reported sexual abuse in childhood. These rates are consistently higher than rates found within this study sample. Additionally, Rosenberg, Lu, Mueser, Jankowski, and Cournos (2007) found 56% of adults with schizophrenia reported childhood physical abuse, 49% childhood domestic violence, 36% parental separation, 34% sexual abuse, and 21% parental mental illness. While rates of physical abuse and domestic violence were much higher in the Rosenberg et al. (2007) study than in this study, rates of sexual abuse and parental mental illness were similar. However, it is

important to note methodological differences between these studies and the study at hand, as the Rosenberg et al. (2007) and Spidel et al. (2010) studies utilized self-report and this study utilized record review. The current study's record review was comprehensive and provided information beyond self-report, including medical, psychiatric, and social services records, family reports, annual review reports, and discharge summaries. However, because this study utilized record review, it was not possible for researchers to ask clarification or follow-up questions. If there was no documented ACE found within the record, it was noted as absent. Thus, it is plausible that rates of childhood adversity were in fact underreported for the present study's sample.

Aim Two: Chronic Illness and Health-Risk Behavior Prevalence

The second aim of this study was to examine the prevalence of chronic illness and health-risk behaviors in a forensic inpatient mental health setting. There is evidence that chronic illnesses and health-risk behaviors are more prevalent in both incarcerated populations and populations of individuals with severe mental illness. However, no known studies to date have examined this within a forensic mental health inpatient population.

Both the mean and modal number of chronic illnesses for the sample was one, with 27.5% of the population diagnosed with only one of the six conditions. Around 23% of the sample were diagnosed with none of the six conditions, while 35% of the sample was diagnosed with two or more. Hypertension was the most frequently diagnosed of the six conditions examined, followed by high cholesterol, chronic pain, diabetes, and heart disease. Cancer was diagnosed infrequently.

Rates of chronic illness and comorbidity were consistently higher in the present study than a large comparison study of noninstitutionalized American adults. Rates of one or more chronic conditions (76.9% vs. 43.8%), two chronic conditions (16.5% vs. 10.7%), and three or

more conditions (18.5% vs. 13.3%) were consistently higher among the present study population, while rates of no chronic illness (23.1% vs. 56.3%) were much lower (Paez et al., 2009).

Rates of hypertension within the current sample were considerably higher than national comparison data, as study results show that 49.5% of the forensic psychiatric participants carry a hypertension diagnosis, while national comparison rates are only 33% (CDC, 2015). Discrepancies in rates of diabetes (16.5% vs. 12.6%) were less substantial (CDC, 2015). Rates of high cholesterol were also comparable, with 30.2% of the sample diagnosed and 29.8% of national sample diagnosed (CDC, 2015). Similarly, rates of cardiac disease were 11.5% in both study and national samples (CDC, 2015). Cancer rates were slightly lower in the sample compared to national rates (3.3% vs. 6.4%; CDC, 2015). These comparison rates were obtained from a large report compiled by the CDC's National Center for Health Statistics, which summarized national health statistics trends collected from multiple sources with varying methodologies. Sample characteristics are not reported due to the large number of data sources used. Thus, it is possible that the demographic characteristics of these samples differ from the current study's sample, which may impact how these rates compare to the current study's. Such comparisons may in fact underestimate the true discrepancies between a forensic inpatient mental health population and community samples, as this study's sample is likely younger than most community samples (x=32.5 years at admission, 40.5 years at discharge*)* and a significant and positive relationship exists between age and chronic illness.

Rates of chronic pain in the present sample (n=38; 20.9%) were lower than most national rates. One national study of more than 25,000 Americans reported a chronic pain rate of 30.7% (Johannes, Le, Zhou, Johnston, & Dworkin, 2010). However, rates of chronic pain vary significantly due to varying methodologies, definitions of chronic pain, and studied populations.

Verhaak, Kerssens, Dekker, Sorbi, and Bensing (1998) reported chronic pain prevalence rates vary between 2-40%, while Phillips (2009) reported that prevalence rates vary from 8-60%.

De Hert et al. (2011) conducted a literature review examining rates and risk of various health problems within persons with SMI. They found multiple studies that have reported significantly increased risk of diabetes, cardiovascular disease, and coronary heart disease in individuals with SMI in comparison with the general population. However, examination of associations between cancer and SMI produced conflicting results, with some studies showing comparable rates, while others reported increased risk of cancer for those with SMI. Messina and Grella (2006) provided data on various health outcomes for a sample of Californian female inmates. Results showed much lower rates of hypertension than this study (49.5% current study vs. 12% Messina & Grella, 2006) but rates of cardiac conditions (11.5% vs. 11%) were comparable.

Rates of health-risk behaviors were additionally notable within this study. A majority of participants reported alcohol abuse (59%) and evidenced a BMI falling into the overweight or obese category (57.1%). Nearly half of the sample reported marijuana abuse (48.9%). Smoking (35.7%), cocaine abuse (26.9%), and hallucinogen abuse (17.6%) were also frequently endorsed. Rates of heroin (9.9%), methamphetamine (9.3%), prescription drug abuse (7.7%), inhalants (6.6%), and speed (5.5%) were less than ten percent. It is important to note however, that for many participants, due to age and length of hospitalization, methamphetamine and prescription drug abuse were less common when they were in the community. Additionally, access to heroin was likely rare within this sample due to the low functional level of many participants.

Cigarette smoking was more prevalent in the study sample than is reported in national comparison data, with rates of 35.7% and 16.8%, respectively (CDC, 2015). Rates of obesity

were in fact lower in the current study sample, with 26.9% of study participants and 36.5% of those in a national comparison sample having a BMI in the obese range (CDC, 2015). However, it is possible that this may be due to study participants being hospitalized patients, where dietary intake is controlled to facilitate weight loss over time. According to National Institute on Drug Abuse (no date), 16.6% of adults 26 and older report lifetime use of cocaine and 4.1% report lifetime use of crack cocaine, which is much lower than the present study's finding. Additionally, 16.2% of adults over 26 reported use of hallucinogens, 2.1% heroin, 9.6% inhalants, and 6.4% methamphetamine. While rates of hallucinogen, inhalant, and methamphetamine abuse in this study were comparable to the present study's findings, the present study reported higher rates of heroin abuse.

How do rates of health-risk behaviors in the present study's sample compare to those of other psychiatric or forensic populations? Spidel et al. (2010) found among a sample of participants with early psychosis that 56% reported abuse of marijuana, 47% alcohol, 26% cocaine, 22% amphetamine, 10% hallucinogens, and 10% heroin. Additionally, Coodin (2001) found that rates of obesity among a sample of individuals with schizophrenia were more than three times higher than the general population, and Allison et al. (2009) noted doubled rates of obesity among those with SMI as compared to a matched sample without SMI. However, these rates were not specific to individuals in inpatient treatment, thus it is unlikely they were on a controlled diet like those in the current study's sample. Messina and Grella (2006) reported among a sample of female inmates in California that rates of smoking were 84%, much higher than this study's rates. However, it should be noted that the current study's setting instituted a tobacco-free policy approximately ten years ago. A portion of study participants were impacted

by this policy, and thus would not have reported current smoking. While many physicians noted a history of smoking in an individual's medical record, this was not always reported.

Overall, rates of health-risk behaviors vary based on the assessed population and study methodologies. While rates of alcohol abuse and hallucinogen abuse were higher in this study than other examined high-risk populations, rates of marijuana abuse and smoking were lower. The prevalence of cocaine abuse and heroin abuse between studies is comparable.

Aims Three and Four: ACEs, Health-Risk Behavior, and Chronic Illness

The third study aim was to examine relationships between ACEs, health-risk behaviors, and chronic illnesses within a forensic inpatient mental health setting. It was hypothesized that significant and positive relationships would emerge between ACEs and chronic illnesses, health-risk behaviors and chronic illnesses, and ACEs and health-risk behaviors.

ACEs and chronic illness. Models examining associations between ACE score and presence of any chronic condition, number of chronic conditions, and diagnoses of cardiac conditions, hypertension, high cholesterol, cancer, chronic pain, and diabetes emerged as statistically significant. However, with the exception of high cholesterol, associations in all models were accounted for by demographic variables, and ACE score failed to contribute significantly to the variance. In the model examining ACE score and high cholesterol, both ACE score and age were significant. Thus overall, hypothesis two was not supported by findings.

These results are largely inconsistent with prior research using community samples, as a plethora of studies have illustrated significant associations between ACE scores and cardiovascular disease (including hypertension and high cholesterol), diabetes, and chronic pain (Campbell et al., 2016; Felitti et al., 1998; Imbierowicz & Egle, 2003; Lampe et al., 2003; Scott et al., 2011). For instance, Scott et al. (2011) examined associations between childhood

adversity and chronic physical illnesses in adulthood among the general populations of ten countries. Among those reporting three or more ACEs, rates of heart disease, diabetes, osteoarthritis, chronic spinal pain, and headaches were significantly increased. It is important to note, however, that most studies that have established support for the relationship between ACEs and adverse health outcomes in adulthood were conducted with community samples rather than high-risk populations. Thus, results from the present study imply that ACEs are not as singularly predictive of adverse health outcomes in a sample with so little variability in ACE scores as compared to a community sample, where such negative experiences in early childhood are much less common. It is also plausible that high ACE comorbidity, diagnostic comorbidity, and other risk factors may complicate the seemingly direct relationship between aggregate instances of childhood adversity and adult health in this sample.

Health-risk behavior and chronic illness. Numerous studies have also established links between health-risk behaviors and development of chronic illness; thus such relationships were examined within this study. Overall, models examining associations between health-risk behaviors and chronic illnesses in the current study failed to reach significance. While multiple models produced significant results, in most cases health-risk behaviors did not contribute significantly to the variance and significance was driven by age. However, smoking was the exception to this, as it significantly contributed to statistical models examining number of chronic illnesses, presence of any chronic condition, and high cholesterol. Thus overall, hypothesis three was not supported by these findings. This is inconsistent with a significant amount of evidence linking health-risk behaviors to development of chronic illness within community samples.

ACEs and health-risk behavior. One of the most prominent theories linking ACEs to chronic illness is through the adoption of health-risk-behaviors. Models assessing relationships between ACEs and health-risk behaviors within this study found significant relationships between ACE scores and smoking, and abuse of alcohol, marijuana, cocaine, methamphetamine, hallucinogens, and prescription medications. In each of these instances, not only was the overall model significant but ACE score as an individual predictor variable was also statistically significant. Although overall models including demographic and health-risk behaviors did not emerge as significant for speed, heroin, and inhalant abuse, the individual steps where ACEs were added to models emerged as significant for these health-risk variables. Overall, these results support hypothesis four, as significant and positive relationships emerged between ACE scores and multiple health-risk behaviors.

These findings are consistent with the many studies that have established links between health-risk behaviors and childhood adversity. Felitti et al. (1998) found that prevalence and risk for smoking, severe obesity, alcohol dependence, use of illicit drugs, and injection of illicit drugs increased as the number of forms of childhood exposure to adversity increased. Additionally, Chartier and Walker (2009) reported that participants exposed to physical or sexual abuse in childhood were significantly more likely to report smoking or alcohol problems in adulthood. An additional study found that ACE scores significantly increased participants' risk of illicit drug initiation, lifetime use of illicit drugs, ever having a drug problem, and ever being addicted to drugs (Dube et al., 2003).

Multiple theories exist as to why childhood adversity is significantly associated with risky health behaviors. Many of these theories postulate that chronic activation of the body's stress response during childhood adversity can lead to long-term physiological consequences,

such as alterations to sympathetic-adrenomedullary (SAM) reactivity, serotonergic functioning, hypothalamic-pituitary-adrenocortical (HPA) reactivity, and parasympathetic nervous system activation (Repetti, Taylor, & Seeman, 2002). For instance, evidence has shown that children from risky family environments experience serotonergic dysregulation due to both genetic and experiential factors (Repetti et al., 2002). Kostrzewa, Reader, and Descarries (1998) propose that given the mutual influence of serotonin and dopamine functioning on one another, that serotonin dysregulation may alter dopamine regulation, leading to increased risk for substance abuse. Repetti et al. (2002) also proposes that substance abuse may aid adolescents and adults with serotonergic dysregulation by increasing levels of serotonin or uptake inhibition. Additionally, repeated exposure to stress and activation of bodily stress responses in childhood can lead to a heightening of SAM reactivity when faced with stress. Combining this with findings suggesting that children from risky home environments may experience a reduction in parasympathetic nervous system activity, a vital component for reducing the physiological stress response, implies that these children may in fact have stronger and more sustained responses to distress (Repetti et al., 2002), which can increase risk for engaging in health-risk behaviors.

Other theories have explained the relationship between childhood trauma and health-risk behaviors through coping learned in the face of chronic stressors in childhood. For instance, Repitti et al. (2002) argue that children's efforts to change stressful situations in the midst of adverse contexts are often unsuccessful and may lead them to abandon these efforts to instead focus on escape or avoidance. This supposition is supported by research, as multiple studies have shown that children in risky family environments are more likely than peers to use distraction, escape, and tension reduction to cope with distress (Stern & Zevon, 1990). It is plausible that

these children and adolescents may habituate to use of escape and distraction coping techniques when faced with distress, which can later manifest as various health-risk behaviors.

ACEs, health-risk behavior, and chronic illness. As multiple studies have illustrated relationships between ACEs, health-risk behaviors, and chronic illnesses in community samples, the initial data analysis plan included analysis of these variables using mediation modeling. However, as seven of the eight direct relationships between ACE score and chronic illness variables failed to reach significance, only one mediation analysis, that between ACE score and high cholesterol diagnosis, was completed. The relationship between ACE score and the substance abuse factor emerged as significant in this model, but all other relationships failed to reach significance. Thus, support was not offered for health-risk behaviors as mediating variables between ACE score and diagnosis of high cholesterol.

Future Directions

Overall, this study did not provide support for significant associations between ACE scores and chronic illness or associations between health-risk behaviors and chronic illness. Given that a great deal of research has established these links in the past in an array of community samples, these findings were somewhat surprising. However, research provides potential explanations for why these relationships may be less clear in forensic inpatient mental health settings compared to community samples.

One possibility may be that within a population exposed to a greater degree of early childhood adversity, variables not included in the ACE survey may better explain increased rates of chronic illness over ACE scores alone.

Herrenkohl and Herrenkohl (2007) note that many studies examining the long-term impact of abuse, neglect, and domestic violence fail to include environmental stressors in their

analyses. These authors propose that in accordance with ecological theory, negative outcomes do not stem from a single incident or type of adversity but rather factors that exist across various levels of a child's environment, including a child's surrounding community. Consistent with this, there is evidence that family violence is associated with neighborhood disadvantage (such as crime and low income) and violence outside the home (Margolin & Gordis, 2000). Aisenberg and Herrenkohl (2008) expand upon this in discussing community violence as a risk factor for later development of substance abuse, emotional problems, behavior problems, and perpetration of violence. The authors review the disproportionately increased rates of community violence among people of color, those who are financially disadvantaged, and those who live in highly populated areas. Several studies have proposed that in addition to increased risk of violence exposure, youth residing in disadvantaged neighborhoods may also have less access to positive relationships and prosocial role models (Lynch & Cicchetti, 2002; see Aisenberg & Herrenkohl, 2002 for review). Aisenberg and Herrenkohl (2002) go on to discuss how individuals in such neighborhoods may also be exposed to media portrayals of their community as dangerous and crime ridden, which can lead to or exacerbate feelings of despair and powerlessness. These authors also propose that residing in a community with high violence rates may lead to negative outcomes for parents, such as trauma, depression, or economic deprivation, which can in turn negatively impact parenting abilities and parent-child relationships.

Jung et al. (2014) included several environmental factors in an examination of the relationship between childhood maltreatment and adult criminal behavior. Bivariate analyses between childhood maltreatment and adult crime produced significant results. However, findings were no longer significant when variables such as gender, childhood SES, marital status, education status, and minority racial status were included. While gender and minority racial

status were included within the present study, environmental factors such as socioeconomic status, education status, and neighborhood violence and crime were not. Given the many consequences associated with environmental stressors and the association between neighborhood violence and subsequent violent behavior, such environmental considerations should be included in examining factors associated with health outcomes among those in forensic inpatient mental health facilities in future studies.

Multiple studies have also shown an increased risk of adult re-victimization for those exposed to childhood trauma (Barnes, Noll, Putnam, & Trickett, 2009; Messman-Moore & Long, 2000; Widom, Czaji, & Dutton, 2008). While most research in this area has examined childhood sexual trauma, there is also evidence that those exposed to physical abuse in childhood are at increased risk for re-victimization (Coid et al., 2001; Desai, Arias, Thompson, & Basile, 2002). Widom et al. (2000) review several theories on why childhood trauma is linked to later re-victimization. One theory proposes that individuals exposed to childhood trauma may adopt maladaptive beliefs and behaviors (including low self-esteem and learned helplessness) and have less opportunity to learn adaptive behaviors (Filkenhor & Brown, 1985; Wheeler & Berliner, 1988). An additional theory suggests that those exposed to childhood abuse, particularly childhood sexual abuse, may rely on avoidance-style coping, which can lead to later substance abuse that can increase risk of re-victimization (Briere, 1992; Polusny & Follette, 1995). In addition to the increased risk of re-victimization for those who experience childhood trauma, incidence rates of violence in secure forensic settings or other institutions for persons with SMI and histories of violence tend to be high. Given the risk of re-victimization and violence rates in forensic and inpatient mental health facilities, it is possible that participants within this study sample were also exposed to continued traumas in adulthood, which could additionally impact

health. Future studies should seek to include subsequent or continuing trauma in analyses of potential risk factors for negative health outcomes, particularly among high-risk populations where risk factors are not as clearly understood.

As indicated in the present study, it is possible that ACE scores alone are not predictive of long-term health outcomes in high-risk samples and that ACEs should be viewed within a larger context. For instance, Aisenberg and Herrenkohl (2008) suggest that different types of violence exposure can produce varying effects and provide suggestions for assessing community violence more thoroughly. These authors suggest that factors such as a child's relationship to victims of violence, physical proximity to events, as well as the recency and severity of exposure may all affect long-term outcomes. They note, however, that such factors are rarely assessed. In applying such recommendations to examinations of childhood adversity, perhaps variables like proximity to ACEs (e.g. domestic violence witnessed first-hand vs. taking place out of child's view), relationships to family members involved in childhood adversities (e.g. strength of relationship to parent with mental illness or substance dependence, as parent may or may not reside in the home), as well as the severity and chronicity of adversity (e.g., happened once, happened for one year, happened for ten years) could be helpful. It is possible that such factors may in fact be more responsible for the associations between childhood adversity and chronic illness than ACE scores alone in such high-risk populations, given the relatively high numbers of persons exposed to four or more ACEs in these samples.

While this study did not find support for relationships between ACEs and chronic illness and health-risk behavior and chronic illness, the prevalence of ACEs within the current sample was consistent with evidence that both forensic and psychiatric populations are disproportionally exposed to childhood adversity. This study consistently found higher rates of exposure to

individual and cumulative ACEs among the study participants in comparison with a national CDC sample. While there is ample evidence that childhood abuse is associated with poor mental health, psychiatric problems, and increased risk of suicide attempts (Brown et al., 2005; Rosenberg et al., 2007), pathways between ACEs and criminal behavior are less clear. Some research has linked serotonergic dysfunction or low levels of serotonin to aggressive behavior (Raleigh et al., 1986; Repitti et al., 2002; Suomi, 1997). Additionally, it is plausible that increased rates of substance abuse or dependence are related to criminal behavior. Modeling of aggressive behavior in the home by parental figures could also potentially lead to adoption of aggressive behaviors by children in these environments. Given the limited research on these pathways, future research should attempt to further elucidate potential relationships between ACEs and criminal behavior.

Limitations

Several limitations should be considered when interpreting study findings. First, this study utilized only a small subset of six chronic conditions in data collection and analysis. As data collection for the present study was part of a large, multi-disciplinary study, chronic illness was not a primary focus of the overall study. While the present study produced higher rates of chronic illness and comorbidity than non-institutionalized comparison samples, it is possible that given the narrow definition of chronic illness within this study that rates are in fact underestimates of the true prevalence of chronic illnesses in forensic inpatient mental health populations. However, it should be noted that the most commonly reported adult chronic conditions (i.e., diabetes, hypertension, and high cholesterol; Paez et al., 2009), were included within this study.

Several other key factors should be considered when examining results, as they may lead to an underestimation of the true prevalence of chronic illness rates within this study sample. First, this sample was fairly young (*M*=32.5 years at admission, *M*=40.5 years at discharge). As a significant and positive relationship between age and chronic conditions has been established in the literature, it is likely that the prevalence of such conditions in an older forensic inpatient mental health population would be considerably higher. Additionally, while some of the assessed conditions can be diagnosed objectively based on lab results, such as diabetes and hypertension, diagnosis of other illnesses, such as chronic pain, are more subjective. The lack of an objective method for diagnosing chronic pain, combined with the fact that a diagnosis of chronic pain in the chart may have led patients to request analgesics within this highly controlled setting may have led to under-diagnosis by facility providers.

The use of record review for data collection serves as an additional study limitation. Though the records were based on a combination of a variety of sources, including patient self-report, available records from other agencies, and information provided by family members, the information provided to staff members at the facility was for the purpose of clinical assessment and treatment. Thus, it is difficult to assess the degree to which interviewers used a consistent set of questions, queried participants equally, or utilized follow-up questions. Further, if an ACE or other variable of interest was not reported or documented throughout these methods, it was recorded as absent during data collection, which could incorrectly skew study results.

Dichotomous recording of chronic condition and health-risk behavior variables also limits the findings of this study. Dichotomous coding provided limited information on the time-order and duration of both health-risk behaviors and chronic illness diagnoses. For instance, as data are recorded, it is not possible to say when health-risk behaviors were adopted and/or

discontinued, when chronic conditions were diagnosed (i.e., prior to admission to facility, upon admission, during stay), or how long a participant engaged in a risk behavior. This further complicates the analyses examining relationships between health-risk behaviors and chronic illnesses. Studies would benefit from including onset of chronic disease diagnoses and health-risk behaviors in future analyses. Further, as the average length of stay for participants was approximately eight years and they were required to abstain from most health-risk behaviors during this time, it is likely that the impact of a health-risk behaviors would lead to different outcomes than those documented in most of the literature, as in community samples participants are not in a controlled setting and required to discontinue health-risk behaviors.

Comparisons discussed within this study should also be interpreted with caution. Many comparisons were made using these data, specifically with regard to rates of ACEs, health-risk behaviors, and chronic conditions. While these values help illustrate differences between this study's high-risk patient population and general community samples, it is important to note that this study was not sampled for the purposes of comparison, thus study samples were not matched and direct statistical comparisons cannot be made. To allow for statistical comparisons of such groups in future studies, samples should be matched for key variables including age, gender, and race.

Several statistical considerations should also be made when interpreting study results. First, both health-risk behaviors and chronic illness variables were coded and analyzed dichotomously. Dichotomous variables provide much less information than do continuous ones. For instance, a person with diagnosed with a less severe case of diabetes one year prior to admission to the facility would have the same "score" on the diabetes variable as someone with a severe case of diabetes diagnosed decades ago. Further, such dichotomous coding leads to

decreased effect size and less power. Thus, it is possible significant relationships may have been missed using dichotomous, rather than ordinal or continuous, variables. Future studies should seek to examine relationships between ACEs, health-risk behaviors, and chronic illnesses in a less restricted way, such as looking at continuous variables like A1C, blood pressure levels, or years abusing a particular substance.

Conclusion

It was originally proposed that rates of exposure to individual and cumulative ACEs within the study's forensic inpatient mental health setting would be consistently higher than reports from national comparison samples. It was also hypothesized that significant and positive relationships between childhood adversity, chronic illnesses, and health-risk behaviors would emerge within the study sample. This study offered support for increased rates of childhood adversity and a significant relationship between ACE scores and health-risk behaviors within a forensic inpatient mental health population. However, support was not found for relationships between ACEs and chronic illnesses or health-risk behaviors and chronic conditions within this population. The lack of significance in these relationships suggest that different factors may drive the development of chronic illnesses within high-risk populations. Future research could benefit from examining ACE scores through a broader lens, including factors such as severity and chronicity of the adversity as well as proximity to the situation and relationship to involved parties or victims. It is likely also beneficial to assess relationships between environmental stressors such as community violence, socioeconomic status, and education, and long-term health consequences.

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Cook, C. L., Polaha, J., & Williams, S. (2016, Spring). Rural parents' perceptions of mental health services: A qualitative study (Brief Report). *The Community Psychologist, 49*(2), 35-36. Retrieved from http://www.scra27.org/publications/tcp/tcp-past-issues/tcpspring2016/rural/

Presentations:

Cook, C. L., Gouge, N. B.. (2016, October). A feasibility audit of an "incident to"/shared billing protocol. Poster presented at the Collaborative Family Healthcare Association, Charlotte, NC.

Cook, C.L., Stinson, J.D., & Quinn, M.A. (2016, April). Early childhood adversity and chronic illness: An examination of a high-risk forensic inpatient population. Poster presented at Appalachian Student Research Forum, Johnson City, TN.

Hill, S., **Lilly, C.**, Cantrell, P., & Edwards, J. (2014, April). Patient, provider and behavioral health consultant perspectives on barriers to mental health service seeking and utilization in primary care. Roundtable discussant at the Collaborative Conference on Rural Mental Health, Boone, NC.

Lilly, C. E., McCray, S. L., Weierbach, F., & Polaha, J. (2014, February). Evaluation of a blended behavioral telehealth model in a rural health clinic: A patient and provider perspective. Paper presented at the Primary Care and Prevention Research Day, Johnson City, TN.

Lilly, C., & Polaha, J. (2013, November). Technology use in rural Appalachia: A pilot study of the implications for pediatric behavioral health. Poster presented at the Association for Behavioral and Cognitive Therapies: Technology and Behavior Change Special Interest Group, Nashville, TN.

Lilly, C. E., Polaha, J., Williams, S., & Schrift, M. (2013, March). Rural parents' perspectives on mental health services: A qualitative study. Paper presented at the Collaborative Conference on Rural Mental Health Training, Boone, NC.

Tolliver, R. M., **Lilly, C.,** Reed, S., Williams, S., & Polaha, J. (2012, April). Primary care: An opportunity to address behavioral health among rural children. Paper presented at the Collaborative Conference on Rural Mental Health Training, Boone, NC.

Tolliver, R. M., **Lilly, C**., Reed, S., Williams, S., & Polaha, J. (2012, February). Primary care: An opportunity to address behavioral health among rural children. Paper presented at the Primary Care and Prevention Research Day, Johnson City, TN.

Hill, S. K., **Lilly, C. E.,** Brewer, K. G., & Webb, J. R. (November 4, 2011). Dimensions of social support as mediators of the association between religiousness and aggression. Poster presented at the Tennessee Psychological Association, Nashville, TN.

Honors and Awards:

Graduate Poster Session (Society, Behavior, and Learning Group B), *Second Place,* Appalachian Student Research Forum, 2016

Graduate Poster Session, *Third Place,* Tennessee Psychological Association, 2011.

Magna Cum Laude Honors, East Tennessee State University, 2011

Outstanding Sociology Student, East Tennessee State University, 2011

Academic Performance Scholarship, East Tennessee State University, 2008-2011.